HAMMOND ON WAKEFULNESS

ON

WAKEFULNESS.

WITH AN

INTRODUCTORY CHAPTER

ON THE

PHYSIOLOGY OF SLEEP.

BY

WILLIAM A. HAMMOND, M.D.,

Fellow of the College of Physicians of Philadelphia; Member of the Philadelphia Pathological Society; of the Academy of Natural Sciences; of the American Philosophical Society; Honorary Corresponding Member of the British Medical Association; Member of the Verein für Gemeinschaftliche Arbeiten zur Föderung der Wissenschaftlichen Heilkunde; Honorary Member of the Verein Württembergischer Wundaerzte und Geburtshelfer; late Professor of Anatomy and Physiology in the University of Maryland; late Surgeon to the Baltimore Infirmary, and late Surgeon-General of the United States Army; author of "Physiological Memoirs," "A Treatise on Hygiene," "Lectures on Venereal Diseases," etc. etc.

PHILADELPHIA:

J. B. LIPPINCOTT & CO.

1866.

I INSCRIBE

THIS LITTLE VOLUME

TO

DR. J. H. DOUGLAS,

OF NEW YORK,

ONE OF THE MOST ACCOMPLISHED OF PHYSICIANS,

BEST OF MEN,

AND TRUEST OF FRIENDS.

PREFACE.

THE basis of this monograph is an essay "On Sleep and Insomnia," published in the *New York Medical Journal* for May and June of this year. It has been very materially enlarged, and in some parts entirely rewritten, and is now published at the suggestion of several friends, who were of the opinion that it was deserving of a more permanent form than that afforded by the pages of a periodical.

I am not without the hope, with them, that it may prove to be a useful addition to medical literature.

162 WEST THIRTY-FOURTH STREET,
NEW YORK, October 25th, 1865.

CONTENTS.

CHAPTER I.

CHAPTER II.

CHAPTER III.

CHAPTER IV.

ON WAKEFULNESS.

CHAPTER I.

INTRODUCTORY.

Physiology of Sleep.

BEFORE we can arrive at a correct idea of the pathology of a disease, we must form a clear conception of the physiology of the organs and functions involved. It is impossible, therefore, to understand that part of the subject under consideration which relates to sleeplessness, till we have received well-defined and true impressions relative to the healthy performance of the function of sleep, and the condition of the brain during the state of comparative quiescence which results; and as recent investigations have thrown a great deal of light upon these subjects, it will not be unprofitable to recall some of the principal points connected with them to our recollection.

The state of general repose which accompanies sleep is of especial value to the organism in allowing the nutrition of the nervous tissue to go on at a greater rate than its destructive metamorphosis. The same effect is, of course, produced upon the other structures of the body; but this is not of so much importance as regards them, for while we are fully awake they all obtain a not inconsiderable amount of rest. Even those actions

which are most continuous, such as respiration and the pulsation of the heart, have distinct periods of suspension. Thus, after the contraction and dilatation of the auricles and ventricles of the heart, there is an interval during which the organ is at rest. This amounts to one-fourth of the time requisite to make one pulsation and begin another. During six hours of the twenty-four the heart is, therefore, in a state of complete repose. If we divide the respiratory act into three equal parts, one will be occupied in inspiration, one in expiration, and the other by a period of quiescence. During eight hours of the day, therefore, the muscles of respiration and the lungs are inactive. And so with the several glands. Each has its time for rest. And of the voluntary muscles, none, even during our most untiring waking moments, are kept in continued action.

But for the brain there is no rest, except during sleep, and even this condition is, as we all know, only one of comparative quietude in many instances. So long as an individual is awake, there is not a single second of his life during which the brain is altogether inactive; and even while he is deprived by sleep of the power of volition, nearly every other faculty of the mind is capable of being exercised; and several of them, as the imagination and memory, for instance, are sometimes carried to a pitch of exaltation not ordinarily reached by direct and voluntary efforts. But for the fact that all parts of the brain are not in action at the same time, and that thus some slight measure of repose is afforded, it would probably be impossible for the organ to maintain itself in a state of integrity.

Causes of Sleep.—The *exciting cause* of natural and periodic sleep is undoubtedly to be found in the fact that

the brain at stated times feels the necessity for repose, and for replacing the substance which has been destroyed by the active discharge of its functions. The brain is no exception to the law which prevails throughout the whole domain of organic nature, that use causes decay. The following extract from another work* bears upon this point, and I think tends to its elucidation.

"During life the fluids and tissues of the body are constantly undergoing change. New matter is deposited, and the old is removed with ceaseless activity. The body may be regarded as a complex machine, in which the law, that force is only generated by decomposition, is fully carried out. Every motion of the body, every pulsation of the heart, every thought which emanates from the encephalon is accompanied by the destruction of a certain amount of tissue. As long as food is supplied in abundance, and the assimilative functions are not disordered, reparation proceeds as rapidly as decay, and life is the result; but should nutrition be arrested, by any cause, for any considerable period, new matter ceases to be formed, and the organs, worn out, act no longer, and death ensues.

"The animal body differs from any inorganic machine in the fact that it possesses the power of self-repair. In the steam-engine, for instance, the fuel which serves for the production of steam, and subsequently for the creation of force, can do nothing toward the repair of the parts which have been worn out by use. Day by day, by constant attrition and other causes, the engine becomes less perfect, and eventually must be put in order by the workman. In the animal body, however, the

* See the author's Treatise on Hygiene, page 92.

material which serves for the production of force is the body itself, and the substances which are taken as food are assimilated according to their character by those organs and parts which require them.

"The body is therefore undergoing continued change. The hair of yesterday is not the hair of to-day; the muscle which extends the arm is not identically the same muscle after as before its action; old material has been removed and new has been deposited to an equal extent; and though the weight and form, the chemical constitution and histological character have been preserved, the identity has been lost."

All this is especially true of the brain. Its substance is consumed by every thought, by every action of the will, by every sound that is heard, by every object that is seen, by every substance that is touched, by every odor that is smelled, by every painful or pleasurable sensation, and so each instant of our lives witnesses the decay of some portion of its mass and the formation of new material to take its place. The necessity for sleep is due to the fact that during our waking moments the formation of the new substance does not go on as rapidly as the decay of the old. The state of comparative repose which attends upon this condition allows the balance to be restored, and hence the feeling of freshness and rejuvenation we experience after a sound and healthy sleep. The more active the mind the greater the necessity for sleep, just as with a steamer, the greater the number of revolutions its engine makes the more imperative is the demand for fuel.

The power with which this cause can act is oftentimes very great, and not even the strongest exertion of the will is able to neutralize it. I have frequently seen

soldiers sleep on horseback during night marches, and have often slept thus myself. Even when the most stirring events are transpiring, some of the participants may fall asleep. Sentinels on posts of great danger cannot always resist the influence. To punish a man with death, therefore, for yielding to an inexorable law of his being, is not the least of the barbarous customs which are still in force in civilized armies. During the battle of the Nile many of the boys engaged in handing ammunition fell asleep, notwithstanding the noise and confusion of the action and the fear of punishment. And it is said that on the retreat to Corunna whole battalions of infantry slept while in rapid march. Even the most acute bodily sufferings are not always sufficient to prevent sleep. I have seen individuals who had been exposed to great fatigue, and who had while enduring it met with accidents requiring surgical interference, sleep through the pain caused by the knife. Damiens, who attempted the assassination of Louis XV. of France, and who was sentenced to be torn to pieces by four horses, was for an hour and a half before his execution subjected to the most infamous tortures, with red-hot pincers, melted lead, burning sulphur, boiling oil, and other diabolical contrivances, yet he slept on the rack, and it was only by continually changing the mode of torture, so as to give a new sensation, that he was kept awake. He complained, just before his death, that the deprivation of sleep was the greatest of all his torments.

Dr. Forbes Winslow* quotes from the *Louisville Semi-Monthly Medical News* the following case:

"A Chinese merchant had been convicted of murder-

* On Obscure Diseases of the Brain, etc. London, 1860, p. 604, note.

ing his wife, and was sentenced to die by being deprived of sleep. This painful mode of death was carried into effect under the following circumstances: The condemned was placed in prison under the care of three of the police guard, who relieved each other every alternate hour, and who prevented the prisoner falling asleep night or day. He thus lived nineteen days without enjoying any sleep. At the commencement of the eighth day his sufferings were so intense that he implored the authorities to grant him the blessed opportunity of being strangled, guillotined, burned to death, drowned, garotted, shot, quartered, blown up with gunpowder, or put to death in any conceivable way their humanity or ferocity could invent. This will give a slight idea of the horrors of death from want of sleep."

So much for the *exciting* cause of natural sleep. Before considering the other agents which may induce sleep, it will be well to inquire into the *immediate* cause of this condition, and first we must endeavor to ascertain what changes, if any, take place in the brain itself which may give rise to sleep.

It is well established as regards other viscera, that during a condition of activity there is more blood in their tissues than while they are at rest. It is strange, therefore, that, relative to the brain, the contrary doctrine should have prevailed so long, and that even now, after the subject has been so well elucidated by exact observation, it should be the generally received opinion that during sleep the cerebral tissues are in a state approaching congestion. Thus Dr. Marshall Hall,* while contending for this view, also advances the theory that

* Observations in Medicine. Second Series, p. 27.

there is a special set of muscles, the duty of which is, by assuming a condition of tonic contraction, so to compress certain veins as to prevent the return of the blood from the heart.

Dr. Carpenter* is of the opinion that the first cause of sleep in order of importance is the pressure exerted by distended blood-vessels upon the encephalon.

Sir Henry Holland† declares that a "degree of pressure is essential to perfect and uniform sleep."

Dr. Dickson‡ regards an increased determination of blood to the cerebral mass, and its consequent congestion in the larger vessels of the brain, as necessary to the induction of sleep.

In his very excellent work on Epilepsy, Dr. Sieveking§ says:

"Whether or not there is actually an increase in the amount of blood in the brain during sleep, and whether, as has been suggested, the choroid plexuses become turgid or not, we are unable to affirm otherwise than hypothetically; the evidence is more in favor of cerebral congestion than of the opposite condition inducing sleep—evidence supplied by physiology and pathology." Dr. Sieveking does not, however, state what this evidence is.

Barthez|| is of the opinion that during sleep there is a general plethora of the smaller blood-vessels of the

---

* Art. *Sleep*. Cyclopedia of Anatomy and Physiology, vol. iv. part 1, p. 681.

† Chapters on Mental Physiology. London, 1852, p. 105.

‡ Essays on Life, Sleep, Pain, etc. Philadelphia, 1852, pp. 63 and 64.

§ Epilepsy and Epileptiform Seizures. London, 1858, p. 123.

|| Nouveaux Elements de la Science de l'Homme. 3me edition. Paris, 1858, vol. ii. p. 7, et seq.

whole body. He does not appear to have any definite views relative to the condition of the cerebral circulation.

To come to more popular books than those from which we have quoted, we find Mr. Lewes,* when speaking of the causes of sleep, asserting that: "It is caused by fatigue, because one of the natural consequences of continued action is a slight congestion; and it is the *congestion* which produces sleep. Of this there are many proofs." Mr. Lewes omits to specify these proofs.

Macnish† holds the view that sleep is due to a determination of blood to the head.

That a similar opinion has prevailed from very ancient times, it would be easy to show. I do not, however, propose to bring forward any further citations on this point, except the following, from a curious old black-letter book now before me, in which the views expressed, though obscure, are perhaps as intelligible as many met with in books of our own day:

"And the holy scripture in sundrie places doth call death by the name of sleepe, which is meant in respect of the resurrection; for, as after sleepe we hope to wake, so after death we hope to rise againe. But that definition which Paulus Ægineta maketh of sleepe, in my judgment, is most perfect where he saith: Sleepe is the rest of the pores animall, proceeding of some profitable humour moistening the braine. For here is shewed by what means sleepe is caused; that is, by vapours and fumes rising from the stomache to the head, where through coldness of the braine they being congealed,

* The Physiology of Common Life. New York, 1860, vol. ii. p. 305.
† Philosophy of Sleep. Second edition, 1850, p. 5.

doe stop the conduites and waies of the senses, and so procure sleepe, which thing may plainly be perceived hereby; for that immediately after meate we are most prone to sleepe, because then the vapours ascende most abundantly to the braine, and such things as be most vaporous do most dispose to sleepe, as wine, milke, and such like."*

The theory that sleep is due directly to pressure of blood-vessels, filled to repletion, upon the cerebral tissues, doubtless originated in the fact that a comatose condition may be thus induced. This fact has long been known. Servetus, among other physiological truths, distinctly announces it in his *Christianismi Restitutio*, when he says:

"*Et quando ventriculi ita opplentur pituita, ut arteriæ ipsæ chloroidis ea immergantur, tunc subito generatur appoplexia.*"

Perhaps the theory which prevails at present, of sleep being due to the pressure of distended blood-vessels upon the choroid plexus, is derived from these words of Servetus.

That stupor may be produced by pressure upon the brain admits of no doubt. It is familiarly known to physicians, surgeons, and physiologists; the two former meet with instances due to pathological causes every day, and the latter bring it on at will in their laboratories. But this form of coma and sleep are by no means identical. On the contrary, the only point of

---

* The Haven of Health, chiefly made for the comfort of Students, and consequently for all those that have a care for their health, etc. By Thomas Cogan, Master of Arts and Batchelor of Physic. London, 1612, p. 332.

resemblance between the two consists in the fact that both are accompanied by a loss of volition. It is true, we may often arrive at a correct idea of a physiological process from determining the causes and phenomena of its pathological variations, but such a course is always liable to lead to great errors, and should be conducted with every possible precaution. In the matter under consideration it is especially of doubtful propriety, for the reason stated, that coma is not to be regarded as a modification of sleep, but as a distinct morbid condition. Sir T. C. Morgan,* in alluding to the fact that sleep has been ascribed to a congested state of the brain, for the reason that in apoplectic stupor the blood-vessels of that organ are abnormally distended, objects to the theory, on the ground that it assimilates a dangerous malady to a natural and beneficial process. He states (what was true at the time he wrote) that the condition of the circulation through the brain, during sleep, is wholly unknown.

It is important to understand clearly the difference between stupor and sleep, and it is very certain that the distinction is not always made by physicians; yet the causes of the two conditions have almost nothing in common, and the phenomena of each are even more distinct.

1. In the first place, stupor never occurs in the healthy individual, while sleep is a necessity of life.

2. It is easy to awaken a person from sleep, while it is often impossible to arouse him from stupor.

3. In sleep the mind is active, in stupor it is as it were dead.

---

* Sketches of the Philosophy of Life. London, 1819, p. 262.

4. Pressure upon the brain, intense congestion of its vessels, the circulation of poisoned blood through its substance cause stupor, but do not induce sleep. For the production of the latter condition a diminished supply of blood to the brain, as will be fully shown hereafter, is necessary.

Perhaps no one agent so distinctly points out the difference between sleep and stupor as opium and its several preparations. A small dose of this medicine acting as a stimulant increases the activity of the cerebral circulation, and excites a corresponding increase in the rapidity and brilliancy of our thoughts. A larger dose lessens the amount of blood in the brain, and induces sleep. A very large dose sometimes diminishes the power of the whole nervous system, lessens the activity of the respiratory function, and hence allows blood which has not been properly subjected to the influence of the oxygen of the atmosphere to circulate through the vessels of the brain. There is nothing in the opium itself which produces excitement, sleep, or stupor, by any direct action upon the brain. All its effects are due to its influence on the heart and blood-vessels, through the medium, however, of the nervous system. This point can be made plainer by adducing the results of some experiments which I have lately performed.

Experiment.—I placed three dogs of about the same size under the influence of chloroform, and removed from each a portion of the upper surface of the skull an inch square. The dura mater was also removed, and the brain exposed. After the effects of the chloroform had passed off—some three hours subsequent to the operation—I administered to number one the fourth of a grain of opium, to number two a grain, and to number

three two grains. The brain of each was at the time in a perfectly natural condition.

At first the circulation of the blood in the brain was rendered more active, and the respiration became more hurried. The blood-vessels, as seen through the openings in the skulls, were fuller and redder than before the opium was given, and the brain of each animal rose through the hole in the cranium. Very soon, however, the uniformity which prevailed in these respects was destroyed. In number one the vessels remained moderately distended and florid for almost an hour, and then the brain slowly regained its ordinary appearance. In number two the active congestion passed off in less than half an hour, and was succeeded by a condition of very decided shrinking, the surface of the brain having fallen below the surface of the skull, and become pale. As these changes supervened, the animal gradually sank into a sound sleep, from which it could easily be awakened. In number three the surface of the brain became dark, almost black, from the circulation of blood containing a superabundance of carbon, and owing to diminished action of the heart and vessels it sank below the level of the opening, showing, therefore, a diminished amount of blood in its tissue. At the same time the number of respirations per minute fell from 26 to 14, and they were much weaker than before. A condition of complete stupor was also induced from which the animal could not be aroused. It persisted for two hours. During its continuance, sensation of all kind was abolished, and the power of motion was altogether lost.

It might be supposed that the conditions present in numbers two and three differed only in degree. That

this was not the case is shown by the following experiment:

Experiment.—To the dogs two and three I administered on the following day, as before, one and two grains of opium respectively. As soon as the effects began to be manifested upon the condition of the brain, I opened the trachea of each, and, inserting the nozzle of a bellows, began the process of artificial respiration. In both dogs the congestion of the blood-vessels of the brain disappeared. The brain became collapsed, and the animals fell into a sound sleep, from which they were easily awakened. If the action of the bellows was stopped and the animals were left to their own respiratory efforts, no change ensued in number two, but in number three the surface of the brain became dark, and stupor resulted.

In order to be perfectly assured upon the subject, I proceeded as follows with another dog:

Experiment.—The animal was trephined as was the others, and five grains of opium given. At the same time the trachea was opened and the process of artificial respiration instituted. The brain became slightly congested, then collapsed, and sleep ensued. The sleep was sound, but the animal was easily awakened by tickling its ear. After I had continued the process for an hour and a quarter, I removed the nozzle of the bellows, and allowed the animal to breathe for itself. Immediately the vessels of the brain were filled with black blood, and the surface of the brain assumed a very dark appearance.

The dog could no longer be aroused, and died one hour and a quarter after the process was stopped.

I have only stated those points of the experiments cited which bear upon the subject under consideration,

reserving for another occasion others of great interest. It is, however, shown that a small dose of opium excites the mind, because it increases the amount of blood in the brain; that a moderate dose causes sleep, because it lessens the amount of blood; and that a large dose produces stupor by impeding the respiratory process, and hence allowing blood loaded with carbon, and therefore poisonous, to circulate through the brain.

It is also shown that the condition of the brain during stupor is very different from that which exists during sleep. In the one case its vessels are loaded with dark blood; in the other they are comparatively empty, and the blood remains florid.

I think it will be sufficiently established, in the course of these remarks, that sleep is directly caused by the circulation of a less quantity of blood through the cerebral tissues than traverses them while we are awake. This is the immediate cause of healthy sleep. Its exciting cause is, as we have seen, the necessity for repair. The condition of the brain which is favorable to sleep may also be induced by various other causes, such as heat, cold, narcotics, anæsthetics, intoxicating liquors, loss of blood, etc. If these agents are allowed to act excessively, or others, such as carbonic oxide, and all those which interfere with the oxygenation of the blood, are permitted to exert their influence, stupor results.

The theory above enunciated, although proposed in a modified form by Blumenbach several years since, and subsequently supported by facts brought forward by other observers, has not been received with favor by any considerable number of physiologists. Before, therefore, detailing my own experience, I propose to adduce a few of the most striking proofs of its correctness which I

have been able to collect, together with the opinions of some of those inquirers who have recently studied the subject from this point of view.

Blumenbach* details the case of a young man, eighteen years of age, who had fallen from an eminence and fractured the frontal bone, on the right side of the coronal suture. After recovery took place a hiatus remained, covered only by the integument. While the young man was awake this chasm was quite superficial, but as soon as sleep ensued it became very deep. The change was due to the fact that during sleep the brain was in a collapsed condition. From a careful observation of this case, as well as from a consideration of the phenomena attendant on the hibernation of animals, Blumenbach† arrives at the conclusion that the proximate cause of sleep consists in a diminished flow of oxygenated blood to the brain.

Playfair‡ thinks that sleep is due to "a diminished supply of oxygen to the brain."

Dendy§ states that there was, in 1821, at Montpellier, a woman who had lost part of her skull, and the brain and its membranes lay bare. When she was in deep sleep the brain remained motionless beneath the crest of the cranial bones; when she was dreaming it became somewhat elevated; and when she was awake it was protruded through the fissure in the skull.

Among the most striking proofs of the correctness of the view that sleep is due to diminished flow of blood to

---

* Elements of Physiology. Translated by John Elliotson, M.D., etc. 4th edition. London, 1828, p. 191.

† Op. cit. p. 282, et seq.

‡ Northern Journal of Medicine, No. 1, 1844, p. 34.

§ The Philosophy of Mystery. London, 1841, p. 283.

the head, are the experiments of Dr. Alexander Fleming,* late Professor of Medicine, Queen's College, Cork. This observer states, that while preparing a lecture on the mode of operation of narcotic medicines, he conceived the idea of trying the effect of compressing the carotid arteries on the functions of the brain. The first experiment was performed on himself, by a friend, with the effect of causing immediate and deep sleep. The attempt was frequently made, both on himself and others, and always with success. "A soft humming in the ears is heard; a sense of tingling steals over the body, and in a few seconds complete unconsciousness and insensibility supervene, and continue so long as the pressure is maintained."

Dr. Fleming adds, that whatever practical value may be attached to his observations, they are at least important as physiological facts, and as throwing light on the causes of sleep. It is remarkable that his experiments have received so little notice from physiologists.

Dr. Bedford Brown,† of North Carolina, has recorded an interesting case of extensive compound fracture of the cranium, in which the opportunity was afforded him of examining the condition of the cerebral circulation while the patient was under the influence of an anæsthetic, preparatory to the operation of trephining being performed. A mixture of ether and chloroform was used. Dr. Brown says:

"Whenever the anæsthetic influence began to subside, the surface of the brain presented a florid and injected

---

* British and Foreign Medico-Chirurgical Review, Am. ed. April, 1855, p. 404.

† American Journal of the Medical Sciences. October, 1860, p. 399.

appearance. The hemorrhage increased, and the force of the pulsation became much greater. At these times so great was the alternate heaving and bulging of the brain, that we were compelled to suspend operations until they were quieted by a repetition of the remedy. Then the pulsations would diminish, the cerebral surface recede within the opening of the skull, as if by collapse; the appearance of the organ becoming pale and shrunken with a cessation of the bleeding. In fact, we were convinced that diminished vascularity of the brain was an invariable result of the impression of chloroform or ether. The changes above alluded to recurred sufficiently often, during the progress of the operation, in connection with the anæsthetic treatment, to satisfy us that there could be no mistake as to the cause and effect."

It will be shown, in the course of the present memoir, that Dr. Brown's conclusions, though in the main correct, are erroneous so far as they relate to the effect of chloroform upon the cerebral circulation; nor does it appear that he employed this agent unmixed with ether, in the case which he has recorded so well. He has, probably, based his remarks on this point upon the phenomena observed when the compound of ether and chloroform was used—the action of pure chloroform, as regards its effect upon the quantity of blood circulating through the brain, being the reverse of that which he claims for it.

But the most philosophical and most carefully digested memoir upon the proximate cause of sleep, which has yet been published, is that of Mr. Durham.* Although my

* The Physiology of Sleep. By Arthur E. Durham. Guy's Hospital Reports, 3d Series, vol. vi. 1860, p. 149.

own experiments in the same direction, and which will be hereafter detailed, were of prior date, I cheerfully yield all the honor which may attach to the determination of the question under consideration to this gentleman, who has not only worked it out independently, but has anticipated me several years in the publication, besides carrying his researches to a much further point than my own extended.

With the view of ascertaining by ocular examination the vascular condition of the brain during sleep, Durham placed a dog under the influence of chloroform, and removed with a trephine a portion of bone as large as a shilling from the parietal region; the dura mater was also cut away. During the continuance of the anæsthetic influence, the large veins of the surface of the pia mater were distended, and the smaller vessels were full of dark-colored blood. The longer the administration of the chloroform was continued, the greater was the congestion. As the effects of this agent passed off, the animal sank into a natural sleep, and then the condition of the brain was very materially changed. Its surface became pale and sank down below the level of the bone; the veins ceased to be distended, and many which had been full of dark blood could no longer be distinguished. When the animal was roused, the surface of the brain became suffused with a red blush, and it ascended into the opening through the skull. As the mental excitement increased, the brain became more and more turgid with blood, and innumerable vessels sprang into sight. The circulation was also increased in rapidity. After being fed, the animal fell asleep, and the brain again became contracted and pale. In all these observations the contrast between the two conditions was exceedingly well marked.

To obviate any possible effects due to atmospheric pressure, watch-glasses were applied to the opening in the skull, and securely cemented to the edges with Canada balsam. The phenomena observed did not differ from those previously noticed; and, in fact, many repetitions of the experiment gave like results.

Durham, in the next place, applied ligatures to the jugular and vertebral veins, with the effect—as was to be expected—of producing intense congestion of the brain, attended with coma. This last condition he very properly separates from sleep, which is never caused by pressure from the veins. He likens sleep to the state induced by preventing the access of blood to the brain through the carotid, but does not allude to Fleming's researches on this point.

From his observations Durham deduces the following conclusions:

"1. Pressure of distended veins upon the brain is not the cause of sleep, for during sleep the veins are not distended; and when they are, symptoms and appearances arise which differ from those which characterize sleep.

"2. During sleep the brain is in a comparatively bloodless condition, and the blood in the encephalic vessels is not only diminished in quantity, but moves with diminished rapidity.

"3. The condition of the cerebral circulation during sleep is, from physical causes, that which is most favorable to the nutrition of the brain tissue; and, on the other hand, the condition which prevails during waking is associated with mental activity, because it is that which is most favorable to oxydation of the brain substance, and to various changes in its chemical constitution.

"4. The blood which is derived from the brain during sleep is distributed to the alimentary and excretory organs.

"5. Whatever increases the activity of the cerebral circulation tends to preserve wakefulness; and whatever decreases the activity of the cerebral circulation, and, at the same time, is not inconsistent with the general health of the body, tends to induce and favor sleep. Such circumstances may act primarily through the nervous or through the vascular system. Among those which act through the nervous system, may be instanced the presence or absence of impressions upon the senses, and the presence or absence of exciting ideas. Among those which act through the vascular system, may be mentioned unnaturally or naturally increased or decreased force or frequency of the heart's action.

"6. A probable explanation of the reason why quiescence of the brain normally follows its activity, is suggested by the recognized analogical fact that the products of chemical action interfere with the continuance of the action by which they are produced."

Having thus, in as succinct a manner as possible, brought forward the principal observations relative to the immediate cause of sleep, which up to the present have been published, I come, in the next place, to detail the results of my own researches.

In 1854 a man came under my observation who had, through a frightful railroad accident, lost about eighteen square inches of his skull. There was thus a fissure of his cranium three inches wide and six inches long. The lost portion consisted of a great part of the left parietal, and part of the frontal, occipital, and right parietal bones. The man, who was employed as a wood chopper, was

subject to severe and frequent epileptic fits, during which I often attended him. In the course of my observations, I soon became acquainted with the fact that, at the beginning of the comatose condition which succeeded the fits, there was invariably an elevation of that portion of the scalp covering the deficiency in the cranium. As the stupor passed away, and sleep from which he could easily be aroused ensued, the scalp gradually became depressed. When the man was awake, the region of scalp in question was always nearly on a level with the upper surface of the cranial bones. I also noticed on several occasions that during natural sleep the fissure was deeper, and that in the instant of awaking, the scalp covering it rose to a much higher level.

After my attention was thus drawn to this subject, I observed that in young infants the portion of scalp covering the anterior fontanelle was always depressed during sleep, and elevated during wakefulness.

During the summer of 1860 I undertook a series of experiments, with the view of ascertaining the condition of the cerebral circulation during sleep, of which the following is a brief abstract:

A medium-sized dog was trephined over the left parietal bone, close to the sagittal suture, having previously been placed under the full anæsthetic influence of ether. The opening made by the trephine was enlarged with a pair of strong bone-forceps, so as to expose the dura mater to the extent of a full square inch. This membrane was then cut away and the brain brought into view. It was sunk below the inner surface of the skull, and but few vessels were visible. Those which could be perceived, however, evidently conveyed dark blood, and the whole exposed surface of the brain was of a purple

color. As the anæsthetic influence passed off, the circulation of the blood in the brain became more active. The purple hue faded away, and numerous small vessels filled with red blood became visible; at the same time the volume of the brain increased, and when the animal became fully aroused, the organ protruded through the opening in the skull to such an extent that, at the most prominent part, its surface was more than a quarter of an inch above the external surface of the cranium. While the dog continued awake, the condition and position of the brain remained unchanged. After the lapse of half an hour, sleep ensued. While this state was coming on I watched the brain very attentively. Its volume slowly decreased; many of its smaller blood-vessels became invisible, and finally it was so much contracted that its surface, pale and apparently deprived of blood, was far below the level of the cranial wall.

Two hours subsequently the animal was again etherized, in order that the influence of the ether upon the cerebral circulation might be observed from the commencement. At the time the dog was awake, and had a few minutes previously eaten a little meat and drank a small quantity of water. The brain protruded through the opening in the skull, and its surface was of a pink hue, with numerous red vessels ramifying over it. The ether was administered by applying to the muzzle of the animal a towel folded into the shape of a funnel, and containing a small sponge saturated with the agent.

As soon as the dog commenced to inspire the ether, the appearance of the brain underwent a change of color, and its volume became less. As the process of etherization was continued, the color of the surface darkened to a deep purple, and it ceased to protrude

through the opening. Finally, when a state of complete anæsthesia was reached, it was perceived that the surface of the brain was far below the level of the cranial fissure, and that its vessels conveyed black blood alone.

Gradually the animal regained its consciousness; the vessels resumed their red color, and the brain was again elevated to its former position. In this last experiment there did not appear to be any congestion of the brain. Had this condition existed, it would have been difficult to account for the diminution in bulk, which certainly took place. There was evidently less blood in the cerebral tissue than there had been previously to the etherization; but this blood, instead of being oxygenated, was loaded with excrementitial matters, and consequently was not fitted to maintain the brain in a condition of activity.

The following morning, the dog being quite lively, I removed the sutures which had been placed in the skin, covering the hole in the cranium, with the view of ascertaining the effects of chloroform upon the brain, when introduced into the system by inhalation. Suppuration had not yet taken place, and the parts were in good condition. The opening in the skull was completely filled by the brain, and the surface of the latter was traversed by a great many small vessels carrying red blood. The chloroform was administered in the same way in which the ether had been given the previous day.

In a few seconds the change in color of the blood circulating in the vessels began to take place, but there was no sinking of the brain below the level of the chasm in the skull. On the contrary, its protrusion was greater than before the commencement of the experiment. There was thus not only unoxygenated blood circulating to too

great an extent through the brain, but there was very decided congestion.

The foregoing experiments were frequently repeated on other dogs, and also on rabbits, with like results. Within a short period I have in part gone over the ground again, without observing any essential point of difference in the effects produced.

I have never repeated Fleming's experiment on the human subject, except in one instance, and then sleep, or a condition resembling it, was instantaneously produced. As soon as the pressure was removed from the carotids, the individual regained his consciousness. On dogs and rabbits, however, I have performed it frequently, and though if the pressure be continued for longer than one minute, convulsions generally ensue, a state of insensibility resembling natural sleep is always the first result. Lately, I have had, through the kindness of my friend, Dr. Van Buren, the opportunity of examining a case which affords strong confirmation of the correctness of the preceding views. It was that of a lady in whom both common carotids were tied for a cirsoid aneurism, involving a great portion of the right side of the scalp. One carotid was tied by the late Dr. J. Kearney Rogers, and the other by Dr. Van Buren, seven years ago, with the effect of arresting the progress of the disease. No peculiar symptoms were observed in consequence of these operations, except the supervention of persistent drowsiness, which was especially well marked after the last operation, and which, even now, is at times quite troublesome.

We thus see that the *immediate* cause of sleep is a diminution of the quantity of blood circulating in the vessels of the brain, and that the *exciting* cause is the

necessity which exists that the loss of substance which the brain has undergone, during its state of greatest activity, should be restored. To use the simile of the steam-engine again, the fires are lowered and the operatives go to work to repair damages and put the machine in order for next day's work.

Whatever cause is capable of lessening the quantity of blood in the brain is also capable of inducing sleep. There is no exception to this law, and hence we are able frequently to produce this condition at will. Several of these points have been already referred to, but as two or three of them are important agents in relieving wakefulness, it will be proper to consider them somewhat more at length.

Heat.—Most persons in our climate, and in those of higher temperatures, have felt the influence of heat in causing drowsiness, and eventually sleep, if the action is powerful enough and sufficiently prolonged. It is not difficult to understand the mode by which heat acts in giving rise to sleep. During the prevalence of high temperatures the blood flows in increased proportion to the surface of the body and to the extremities, and consequently the quantity in the brain is diminished. Sleep accordingly results unless the irritation induced by the heat is so great as to excite the nervous system. Heat applied directly to the head exerts, of course, a directly contrary effect upon the cerebral circulation, as we see in sun-stroke. Here there is internal cerebral congestion, loss of consciousness, stupor, etc.

That the effect of heat is to dilate the vessels of the part subjected to its influence, can be ascertained by putting the arm or leg into hot water. The swelling of the blood-vessels is then very distinctly seen. It will be

shown hereafter that one of the best means of causing sleep in morbid wakefulness is the warm-bath.

Cold.—A slight degree of cold excites wakefulness at first, but if the constitution be strong the effect is to predispose to sleep. This it does by reason of the determination of blood to the surface of the body which moderate cold induces in vigorous persons. The ruddy complexion and warmth of the hands and feet produced in such individuals under the action of this influence are well known.

But if the cold be very intense, or the reduction of temperature sudden, the system, even of the strongest persons, cannot maintain a resistance, and then a very different series of phenomena result. Stupor, not sleep, is the consequence. The blood-vessels of the surface of the body contract and the blood accumulates in the internal organs, the brain among them. Many instances are on record showing the effect of extreme cold in producing stupor and even death. One of the most remarkable of these is that related by Captain Cook, in regard to an excursion of Sir Joseph Banks, Dr. Solander, and nine others, over the hills of Terra del Fuego. Dr. Solander, knowing from his experience in Northern Europe that the stupor produced by severe cold would terminate in death unless resisted, urged his companions to keep in motion when they began to feel drowsy. "Whoever sits down will sleep," said he, "and whoever sleeps will rise no more." Yet he was the first to feel this irresistible desire for repose, and entreated his companions to allow him to lie down. He was roused from his stupor with great difficulty and carried to a fire, when he revived. Two black men of the party, whose organizations were not so robust as those of the whites,

perished. Dr. Whiting* relates the case of Dr. Edward Daniel Clarke, the celebrated traveler, who on one occasion came very near losing his life by cold. He had performed divine service at a church near Cambridge and was returning home on horseback, when he felt himself becoming very cold and sleepy. Knowing the danger of yielding to the influence which was creeping over him, he put his horse into a fast trot, hoping thereby to arouse himself from the alarming torpor. This means proving unavailing, he got down and led his horse, walking as fast as he could. This, however, did not long succeed. The bridle dropped from his arm, his legs became weaker and weaker, and he was just sinking to the ground when a gentleman who knew him came up in a carriage and rescued him.

I have often myself noticed this effect of cold in producing numbness and drowsiness, and on one occasion was nearly overcome by it. I was crossing the mountain ridge between Cebolleta and Covero, in New Mexico, when the thermometer fell in about two hours from 52° to 22° Fahrenheit. So great was the effect upon me that if I had had much farther to go I should probably have succumbed. As it was, I reached a rancho in time to be relieved, though several minutes elapsed before I was able to speak. The sensations experienced were rather agreeable than otherwise. There was a great desire to rest and to yield to the languor which was present, and there was a feeling of recklessness which rendered me perfectly indifferent to the consequences. I should have dismounted from my horse and given way to the longing for repose if I had been able to do so. I have several times

* Cyclopedia of Practical Medicine, article *Cold.*

experienced very similar effects from change of air. A few years since I was so drowsy at the sea-coast, whither I had gone from a hot city, that it was with difficulty I could keep awake, even when engaged in active physical exercise.

Another potent cause of sleep, and one of which we generally avail ourselves, is the *diminution of the power of the attention.* To bring this influence into action generally requires only the operation of the will under circumstances favorable to the object in view. Shutting the eyes so as to exclude light, getting beyond the sound of noises, refraining from the employment of the other senses, and avoiding thought of all kind will generally, when there is no preventing cause, induce sleep. To think, and to maintain ourselves in connection with the outward world by means of our senses requires that the circulation of blood in the brain shall be active. When we isolate ourselves from external things, and restrain our thoughts, we lessen the amount of blood in the brain, and sleep results. It is not, however, always easy for us to do this. The nervous system is excited, ideas follow each other in rapid succession, and we lie awake hour after hour vainly trying to forget that we exist. The more the will is brought to bear upon the subject the more rebellious is the brain and the more it will not be forced by such means into a state of quietude. We must then either let it run riot till it is worn out by its extravagancies, or we must fatigue it by requiring it to perform labor which is disagreeable. Just as we might do with an individual of highly destructive propensities, who was going about pulling down his neighbors' houses. We might, if we were altogether unable to stop him, let him alone till he had become thoroughly wearied with

his exertions, or we might divert him from his plan by guiding him to some tough piece of work which would exhaust his strength sooner than would his original labor.

Many ways of thus tiring the brain have been proposed. The more irksome they are, the more likely they are to prove effectual. Counting a hundred backward many times, listening to monotonous sounds, thinking of some extremely disagreeable and tiresome subject, with many other devices have been suggested and have proved more or less effectual. Dr. Dickson* quotes Southey's experience as related in the Doctor,† and I also cannot do better than lay it before the reader, particularly as it indicates several methods which may be more efficacious with others than the one he found to succeed so admirably.

"I put my arms out of bed; I turned the pillow for the sake of applying a cold surface to my cheek; I stretched my feet into the cold corner; I listened to the river and to the ticking of my watch; I thought of all sleepy sounds and of all soporific things,—the flow of water, the humming of bees, the motion of a boat, the waving of a field of corn, the nodding of a mandarin's head on the chimney-piece, a horse in a mill, the opera, Mr. Humdrum's conversations, Mr. Proser's poems, Mr. Laxative's speeches, Mr. Lengthy's sermons. I tried the device of my own childhood, and fancied that the bed rushed with me round and round. At length Morpheus reminded me of Dr. Torpedo's Divinity Lectures, where the voice, the manner, the matter, even the very atmosphere and the streamy candlelight were all alike

* Essays on Life, Sleep, and Pain. Philadelphia, 1852, p. 87.

† The Doctor, etc., edited by Rev. John Wood Warter. London.

somnific; when he who, by strong effort, lifted up his head and forced open the reluctant eyes never failed to see all around him asleep. Lettuces, cowslip wine, poppy syrup, mandragora, hop pillows, spider's web pills, and the whole tribe of narcotics, up to bang and the black-drop, would have failed,—but this was irresistible; and thus, twenty years after date, I found benefit from having attended the course."

Excessive loss of blood produces sleep. We can very readily understand why this should be so if we adopt the theory which has been supported in the foregoing pages. It would be exceedingly difficult to explain the fact upon any other hypothesis. I have seen many instances of somnolency due to this cause. It acts not only by directly lessening the quantity of blood in the brain, but also by so enfeebling the heart's action as to prevent a due supply of blood being sent to the cerebral vessels.

Debility is almost always accompanied by a disposition to inordinate sleep. The brain is one of the first organs to feel the effects of a diminished amount of blood or a depraved quality of this fluid being supplied, and hence, in old age, or under the influence of a deficient quantity of food, or through the action of some exhausting disease, there is generally more sleep than when the physical health is not deteriorated.

The action of certain medicines, and of other measures capable of causing sleep, not coming within the range of ordinary application, will be more appropriately considered hereafter.

CHAPTER II.

THE PATHOLOGY OF WAKEFULNESS.

As nations advance in civilization and refinement, affections of the nervous system become more frequent, because progress in these directions is necessarily accompanied by an increase in the wear and tear of those organs through which perceptions are received and emotions excited; and, in addition, the mode of life, as regards food, clothing, occupation, and habits, is being constantly removed further from that standard which a regard for hygienic considerations would establish as most advantageous. If, as we have every reason to believe, each thought involves the destruction of a certain amount of nervous tissue, we can very well understand why, as we go forward in enlightenment and in all the elements of material and intellectual progress, we are at the same time, unless we also advance in the knowledge of the laws of our being, hurrying ourselves with rapid strides to a state of existence in which there is neither waste nor repair.

I am far, however, from desiring to be understood as intimating that a high state of civilization is antagonistic to long life or health. What is lost in these directions as regards the nervous system is more than made up by the increased provision afforded for comfort in other ways. But while we have improved the hygienic

condition of our cities and dwellings; while we as a rule clothe our bodies according to the principles of sanitary science and common sense; and while cleanliness of person has become the rule and filthiness the exception, we have made little or no progress in the hygienic management of those organs which place us in relation with the world, and a healthy condition of which is so essential to our happiness.

Among the many derangements in the normal operation of the nervous system, induced by irregular or excessive cerebral action, those which relate to the function of sleep are certainly not the least in importance, whether regard be had to the actual comfort of the individual or to the serious consequences to which they may give rise. To the consideration of one of these, morbid wakefulness or insomnia, I propose to devote the remainder of the present memoir.

As a symptom of various diseases which affect the human organism, wakefulness is sufficiently well recognized by systematic writers on the practice of medicine, though, even here, it is very certain that its pathology has seldom been clearly made out. As a functional disorder of the brain, arising from inordinate mental activity, it has received scarcely any notice. This neglect has, doubtless, been in a great measure due to the fact that it is only within late years that the condition in question has become so common as to attract much attention. At present there are, probably, but few physicians engaged in extensive practice in any of our large cities who do not in the course of the year meet with several cases of obstinate wakefulness, unaccompanied, in the early stages at least, by any other prominent disorder of the system.

In my opinion, no one cause is so productive of cerebral affections as persistent wakefulness, for not only is the brain prevented from obtaining rest, but it is kept in a state of erethism, which, if not relieved, must sooner or later end in organic disease. Southey laid the seeds of that disorder which terminated in the loss of his intellect, by watching at the bedside of his sick wife during the night, after the excessive literary labors of the day.* Newton's mind also suffered in the later years of his life through deprivation of sleep;† and Dr. Forbes Winslow, in remarking on Southey's case, says: "No brain can remain in permanent health that has been overtasked by nightly vigils still more than by daily labor."‡

Renaudin,§ in a very philosophical essay, calls attention to the fact that persistent wakefulness is sooner or later followed by insanity, and Maury‖ states his opinion to the same effect. The remarks of Dr. Ray¶ upon this subject are so apposite that I reproduce them in part, commending at the same time the little book from which they are taken to the attention of the reader.

"A periodical renewal of the nervous energies as often as once a day is an institution of nature, none the less necessary to the well-being of the animal economy, because in some degree under the control of the will.

---

* The Scenery and Poetry of the English Lakes. By Charles Mackay, LL.D.

† Life of Sir Isaac Newton. By Sir David Brewster. Vol. ii. p. 240.

‡ On Obscure Diseases of the Brain, etc. London, 1860, p. 609.

§ Sur l'Influence Pathologique de l'Insomnie. Annales Medico-Psychologiques, 3me Série, t. iii. p. 384, et seq.

‖ Le Sommeil et les Rêves. 3me ed. Paris, 1865, p. 9.

¶ Mental Hygiene. Boston, 1863, p. 97.

To disregard its requirements with impunity is no more possible than it is to violate any other organic law with impunity, and no man need flatter himself that he may systematically intrench upon the hours usually devoted to rest and still retain the freshness and elasticity of his faculties. With the same kindliness that marks all the arrangements of the animal economy, this condition is attended with many pleasing sensations and salutary effects, gently alluring us to seek the renovation which it offers. 'While I am asleep,' says the immortal Sancho Panza, 'I have neither fear nor hope; neither trouble nor glory; and blessings on him who invented sleep,—the mantle that covers all human thoughts; the food that appeases hunger; the drink that quenches thirst; the fire that warms; the cold that moderates heat; and, lastly, the general coin that purchases all things; the balance and weight that make the shepherd equal to the king and the simple to the wise.' The ill effects of insufficient sleep may be witnessed on some of the principal organic functions, but it is the brain and nervous system that suffer chiefly and in the first instance. The consequences of a too protracted vigil are too well known to be mistaken, and many a person is suffering, unconscious of the cause, from the habit of irregular and insufficient sleep. One of its most common effects is a degree of nervous irritability and peevishness, which even the happiest self-discipline can scarcely control. That buoyancy of the feelings, that cheerful, hopeful, trusting temper that springs far more from organic conditions than from mature and definite convictions, give way to a spirit of dissatisfaction and dejection; while the even demeanor, the measured activity, are replaced either by a lassitude that renders any ex-

ertion painful, or an impatience and restlessness not very conducive to happiness. Upon the intellectual powers the mischief is still more serious. They not only lose that healthy activity which combines and regulates their movements in the happiest manner, but they are no longer capable of movements, once perfectly easy. The conceptions cease to be clear and well defined, the power of endurance is weakened, inward perceptions are confounded with outward unhappiness, and illusory images obtrude themselves unbidden upon the mind. This kind of disturbance may pass sooner or later into actual insanity, and many a noble spirit has been utterly prostrated by habitual loss of rest."

CASE I.—Several years ago a case similar in several respects to that of Southey came under my observation. A gentleman of superior mind and of great powers of application spent from sixteen to eighteen hours each day in severe literary labor. This of itself would have been a heavy strain to most persons, but he went regularly to bed and slept soundly six hours each night, and it is possible that he might have continued this mode of life for several years without serious inconvenience, when his wife was suddenly taken ill. His anxiety on her account was very great, and he spent nearly the whole night by her bedside, sleeping only for about an hour toward morning. After three weeks passed in this manner, his wife was pronounced out of danger, but he found it impossible to resume his former habits. He could neither study nor sleep. The nights were passed in walking the floor of his chamber or in tossing restlessly on his bed. There were no pain, no fever, no disorder of any other organ. There was nothing but ceaseless activity of the mind and an utter inability to

sleep. Stimulants and narcotics only increased the violence of his symptoms, and every other means employed failed to give relief. The danger of his situation was pointed out to him and travel recommended. He followed the advice, and though it was several months before he was completely relieved, his condition began at once to improve. He was taught a lesson which has not been without influence, in causing him to task his mental faculties less severely.

CASE II.—Another, an intimate friend, who occupied an important public position, gave so much time and attention to his duties, which were of a highly laborious character, that he deprived himself of the amount of sleep to which he had previously been accustomed. It was rarely the case that he got to bed before two or three o'clock in the morning, and then an hour or two was always occupied in active intellection. The consequence was that he finally broke down through want of the mental repose so essential to him. Inflammation of the brain ensued, and this terminated in acute insanity, from which he died.

It would be easy to bring forward other instances of which I am personally cognizant, or which have been cited by authors in illustration of the point in question, but it is scarcely necessary to enlarge further upon this portion of the subject. We should be careful, however, not to mistake the effect for the cause, an error which is often committed in this as well as in other matters. It is well known that many cases of insanity are marked in the early stages by persistent insomnia. Doubtless this is frequently a consequence of the morbid action already set up in the brain, but much observation has satisfied me that it is more often the cause of the cere-

bral aberration, and that by proper medical treatment the mental excitement may be generally allayed. Certainly the means most commonly resorted to in such instances are adopted without the full consideration so imperatively necessary, and consequently are fully as liable to increase as to lessen the disturbance.

We cannot employ too much care in doing everything in our power to prevent the occurrence of those slight attacks of cerebral congestion, which, though perhaps scarcely observable at the time, are yet fraught with very serious consequences. Persons have had their whole characters changed by an apparently trifling interference with the circulation of blood in the head. A person of my acquaintance was naturally of good disposition, amiable in his character, and considerate in his dealings with others, but after an attack of vertigo, attended with unconsciousness of but a few moments' duration, his whole mental organization underwent a radical change. He became deceitful, morose, and exceedingly overbearing and tyrannical toward all with whom he came in contact, and whom it was safe for him to maltreat. Tuke and Bucknill* refer to the case of a lady whose character had always been distinguished for conscientiousness, whose religious education had been of a somber kind, and who, suffering under an attack of small-pox attended with congestion of the brain, recovered, with the natural bent of her disposition greatly exaggerated. The irritability of conscience had become an actual disease, destroying the happiness of the individual and rendering her incompetent to discharge any of the duties of life. The same authors also mention

* A Manual of Psychological Medicine, etc. London, 1858, p. 375.

the instance of a distinguished admiral who had always been remarkable for pride and liability to passionate anger, becoming the subject of cerebral excitement, loss of sleep, and general feverishness consequent upon the chagrin caused by a supposed neglect by the government.

In primary insomnia there is always an increase in the quantity of blood circulating in the brain. This is either absolute or relative. The former is the case when there has been no exhausting disease, hemorrhage, or other debilitating influence in operation, and while, though general good health exists, the amount of blood in the cranium is augmented; the latter, when from any cause the system has become reduced, and when, while this condition prevails, a temporary activity takes place in the cerebral circulation. The first may properly be called active, the latter passive insomnia. In the one there is more blood in the brain than is normally present; in the other, though there may be less blood than in health, the quantity is increased over the amount to which the brain has in a measure accustomed itself.

Thus if we suppose the cerebral vessels of a healthy brain to contain ordinarily a pint of blood, and the amount to be increased to a pint and a half, and continued at this standard for several consecutive days, a state of active insomnia ensues. If, on the other hand, this pint should be reduced to a gill by any cause producing general debility, such as hemorrhage, starvation, or disease, and then by some exciting mental emotion, the excessive use of alcoholic liquors, or other influence acting for a considerable period, be increased to half a pint, a condition of passive insomnia would be produced—the latter condition resulting not from a disturb-

ance of the normal relation existing between the *intra* and *extra* cranial blood, but of that which has been established by morbific causes, and to which the organism has become habituated.

CASE III.—The following is a good example of the active form of morbid wakefulness:

A short time since a gentleman was under my charge in whose case the only deviation from health which could be perceived was an utter inability to sleep. Being by profession a broker, and passing his days, and a great portion of his nights, in the stock and gold rooms, during a period of great financial excitement, his brain had been kept so continually in a state of intense action that it was impossible for him, when he went to bed, to compose his mind so as to allow of sleep ensuing. Thoughts similar to those which were excited during his business operations were in full flow, notwithstanding all his efforts to banish them. Calculations were entered into, and speculations were constantly being formed with as great or even greater facility than during the day. Many of the latter were of the most extravagant character, a fact of which he was fully aware at the time, but he nevertheless found it impossible to refrain from indulging in them. All his other functions were performed with regularity. His appetite was good, he took a not inconsiderable amount of exercise, and he committed no excesses of any kind except as regarded his brain. When I first saw him he had not slept a particle for six nights, although he had taken large quantities of brandy, morphine, and laudanum; but beyond a slight feeling of confusion in his mind at times, and a little pain in his eyeballs, he experienced no unpleasant sensations during the day. As soon, however,

as his head touched the pillow, and he tried to get to sleep, a feeling of the most intense uneasiness came over him, while at the same time his face and ears became hot and flushed. His mental faculties were roused into increased action; he tossed restlessly from one side of the bed to the other, and by the time morning came he was thoroughly exhausted, mentally and physically. A cold bath and a breakfast of two large cups of coffee, beefsteak and eggs, set him up for the balance of the day, till he retired to bed, when the phenomena of the previous night would be repeated.

In this case I conceived that the blood-vessels of the brain, from overdistention, had lost, in a great measure, their contractile power, and that a larger quantity of blood was, in consequence, circulating within the cranium than was normal. The vessels were therefore in a condition very similar to that of a bladder, in which, from the desire to urinate having been too long resisted, contraction cannot be induced even by the most strenuous exertion of the will. As the gentleman was of strong, athletic build, and otherwise in full health, blood-letting would undoubtedly have proved of great service; but, for reasons which will appear hereafter, I determined to try a remedy less likely to do harm, and fully as capable of doing good. I administered thirty grains of the bromide of potassium at six o'clock in the evening, and repeated the dose at ten, directing him to go to bed half an hour subsequently. The first dose produced a decided sedative action, and the second was still more effectual in calming the mental excitement. When he lay down, his mind was not disturbed by a flow of thoughts, and he fell almost unconsciously into a quiet sleep, from which he did not awake till near seven o'clock

the following morning. There were no unpleasant symptoms of any kind; on the contrary, he felt strengthened and refreshed. The next night one dose was administered at about bedtime, which was also followed by a sound and invigorating sleep. No further treatment was given, as on the following night sleep came naturally.

Sir Benjamin Brodie,* without, however, making the distinction I have insisted upon, refers to the active or sthenic type of wakefulness in the following quotations from a little work which should be in the hands of all who are interested in the philosophy of the mind.

Speaking of the causes of the wakefulness of some persons, he says: "At the same time there is no doubt that there is sometimes a morbid condition of the nervous system, the nature of which we cannot well explain, which is incompatible with sleep. The patient says, 'I feel fatigued and wearied and want to go to sleep, but I cannot sleep.'"

In asserting as he does that this kind of wakefulness is sometimes the forerunner of mental derangement, Sir Benjamin is supported by many cases detailed by authors on psychological medicine, and the following, which he gives,† is directly to the point:

"A gentleman of my acquaintance in whose family circumstances had occurred which were to him sources of intense anxiety, passed six entire days and nights without sleep. At the end of this time he became affected with illusions of such a nature that it was necessary to place him in confinement. After some time he

* Psychological Inquiries. Third edition, London, 1856, p. 141.
† Op. cit. p. 142.

recovered perfectly. He had never shown any signs of mental derangement before, nor has any one of his family, and he has never since been similarly affected. This was an extreme case. But do not examples of the want of sleep, proving very similar results, though in a very much less degree, occur under our observation constantly? How altered is the state of mind in any one of us after even two sleepless nights! Many a person who under ordinary circumstances is cheerful and unsuspicious, becomes not only irritable and peevish, but also labors under actual, though transitory, illusions; such, for example, as thinking that others neglect him or affront him who have not the smallest intention of doing either the one or the other."

Cases similar to the following, which is one of the passive variety of wakefulness, are by no means uncommon.

Case IV.—A lady, aged about thirty-five, unmarried, and of rather delicate constitution, consulted me in regard to persistent wakefulness, with which she had been affected for nearly a month. According to the account which she gave me, she had received a severe mental shock, which had not lost its influence when a subject of great anxiety was forced upon her consideration. Her menstrual period, which had been due about ten days before she came under my notice, had been anticipated by a week, and the flow was prolonged much above the ordinary time. She had, therefore, lost a good deal of blood, and was, in consequence, greatly reduced in strength. This, conjoined with the exhaustion due to the long-continued wakefulness, rendered her condition a much more serious one than would otherwise have been the case.

She had taken large doses of laudanum, of ether, and of valerian, together with many other medicines, the names of which I do not now recollect, besides employing a variety of means of traditional efficacy. All had, however, been useless. Homeopathy was then tried with an equal want of success. When I first saw her she was nervous and irritable, her hands trembled violently upon the slightest exertion of their muscles, her eyes were bloodshot, the pupils contracted, and the lids opened to the widest possible extent. There was a constant buzzing in the ears, and the sense of hearing was much more acute than was natural. There was also increased sensibility of all that portion of the surface of the body (the skin of the hands, arms, legs, back, and breast) which I submitted to examination with the æsthesiometer. Her pulse was 98, irritable, small, and weak.

At night all her symptoms were increased in violence. Her mind was filled with the most grotesque images which it was possible for the imagination to conceive, and with trains of ideas of the most exaggerated and improbable character. These succeeded each other with a regularity so well marked that she was able to foresee the routine night after night. "No one," she said, "can imagine the weariness I feel, or the horror with which I look forward to the long rows of too familiar phantoms and thoughts which I know will visit me before morning. There is one set," she continued, "which always comes as the clock strikes two. No matter what may be passing through my mind it is banished by this. It consists of a woman with very long hair, who sits on a rock by the sea-side, with her face buried in her hands. Presently a man armed with a long sword comes up behind her, and, clutching her by the hair, drags her to the

ground. He puts his knee on her breast, and still holding her hair, cuts it off, and binds her with it, hand and foot. He then commences to pile stones on her, and continues to do so till she is entirely covered, notwithstanding her piercing shrieks, which I hear as distinctly as I do real sounds. Turning then to the sea he cries out, 'Julia, you are avenged. My vow is accomplished. Come! come!' He then draws a dagger from his breast and stabs himself to the heart. He falls over the pile of stones he has raised, and instantly hundreds of little devils not more than a foot high swarm around his body, and finally carry it off through the air. My horror at all this is extreme. For more than an hour the scene is passing before me, and though I know it is all purely imaginary, I cannot shake off the terror it induces."

I questioned this lady closely, and found that she was very intelligent, and fully sensible of the unreality of all her visions. There was no evidence whatever of the slightest tendency to insanity, but there was a condition present which would surely terminate in the loss of her reason if not quickly removed. I regarded her symptoms as indicating a state of passive cerebral congestion, and as calling for stimulants rather than what are called sedatives. I directed, therefore, that she should take an ounce of whisky, properly diluted, every hour, commencing six hours before bedtime; that she should immerse her whole body except her head in water, at the temperature of 98° F., for half an hour just before retiring for the night, and, instead of lying down, should sit up in an easy chair and try to sleep in that position.

I administered the whisky upon the same principle that governs us when we apply stimulating lotions to an inflamed eye, or give alcoholic liquors in passive conges-

tions of other parts of the body. The warm bath was prescribed with a view to its dilating action upon the blood-vessels exposed to its influence; and the sitting position with the object of facilitating the flow of blood from the head, and impeding its return through the carotids and vertebrals.

All these measures I had employed previously with success, in many cases of inability to sleep due to delirium tremens, and which is almost always of the passive or asthenic form. In the instance under consideration their action was all that could be desired. At ten o'clock, having taken the whisky and bath as directed, she sat down to sleep in a comfortable chair, and, as her mother informed me, was asleep in less than half an hour. She awoke about three o'clock, but soon fell asleep again after another dose of whisky, and remained in this condition till about nine o'clock in the morning. She then took breakfast, feeling very much refreshed, but was unable to remain awake longer than two or three hours, but, taking to her chair, slept soundly till evening. That night she was again overcome with sleep, and it was passed very much as was the previous one. No further medicine was required, and after a few nights she went to bed as had been her custom, and slept soundly till morning. Under the use of iron and lager beer she recovered her health and strength.

The foregoing cases are given as examples of the two forms of morbid wakefulness or insomnia to which I wish to call attention. They show that, though the cause in each variety may be essentially the same, the means of relief are not altogether identical. It is important, therefore, to discriminate between them. But the main point upon which it is necessary to insist is,

that in morbid wakefulness, whether occurring in strong or weak persons, there is always an excessive amount of blood circulating through the substance of the brain. In the course of the discussion of the points involved in the physiology of sleep, this subject was incidentally noticed. In the following chapter, however, it will be dwelt upon with more particularity.

CHAPTER III.

THE EXCITING CAUSES OF WAKEFULNESS.

EVERY cause capable of increasing the amount of blood ordinarily circulating through the brain may give rise to wakefulness. As these causes are more or less under the control of the individual, it is important that they should be fully considered.

An increased amount of blood is attracted to the brain, and wakefulness is produced:

1st. *By long-continued or excessive intellectual action, or any powerful emotion of the mind.*—Every organ of the body, the condition of which admits of being ascertained by ocular examination, invariably contains more blood in its tissues when in a state of activity than when its functions are temporarily suspended. We are hence, *a priori*, justified in assuming that the law is equally applicable to the brain, but we are not forced to rely entirely upon reasoning from analogy. It has been shown already that during sleep the circulation of blood within the cranium is at its minimum, both as regards quantity and rapidity, and that as soon as the individual awakes there is an immediate afflux of this fluid to the cerebral tissues. All of us are familiar with the facts that, during severe mental labor, or while under the influence of some exciting emotion, the vessels of the head and neck become distended, the head feels full, the face is flushed, and the perspiration of the parts in ques-

tion is increased in quantity. Within certain limits the more blood there is in the brain the more actively its functions are performed, and so well known is this fact that some persons, who require to exercise the several faculties of the mind to an extreme degree, make use of stimulating ingesta for the purpose of accomplishing the object in view.

A moderate degree of cerebral activity is undoubtedly beneficial. Exercise strengthens the mind and improves its faculties, if it is succeeded by a proper period of repose, during which the vessels are emptied to some extent of their contents, and are thus enabled to recover their tone. If, however, the brain is often kept for long periods on the stretch, during which the vessels are filled to repletion, they cannot contract even when the degree of cerebral activity is diminished. Wakefulness results as a necessary consequence, and every day renders the condition of the individual worse, because time also brings the force of habit into operation.

It is not to be denied, however, that many individuals are able to live in comparative health for long periods with but little or no sleep. Thus it is stated* that Boerhaave did not "close his eyes in sleep for a period of *six* weeks, in consequence of his brain being overwrought by intense thought on a profound subject of study." Sir Gilbert Blane† says he was informed by General Pichegru, that for a whole year, while engaged in active campaign operations, he slept but one hour out of the

* On Obscure Diseases of the Brain, etc. By Forbes Winslow, M.D. London, 1860, p. 604.

† Medical Logic, p. 81, quoted in Cyclopedia of Anatomy and Physiology, vol. iv. part i. p. 686.

twenty-four. Such statements as these, however, and others to the same effect which have been made, must be accepted with some allowance. Many persons sleep unconsciously, and we all know how common it is for individuals to deny having slept when we have been eye-witnesses of their somnolency. I should consider it impossible for a person to enjoy good health if deprived for even a few weeks of half his ordinary amount of sleep; and it is very probable that Boerhaave's standard of health, never high, was very much lowered by his protracted vigils.

So long as the attention is kept fully aroused, the blood-vessels of the brain are distended, and it is possible for an individual to remain awake while this condition exists. When the attention begins to flag, the tendency is for the vessels to contract, and for sleep to ensue. This disposition may not, however, be strong enough to restore the full measure of contractility to vessels that have been long overdistended, and then insomnia results.

To this increase in the amount of blood circulating in the brain, many instances of hallucination have been due. It has already been shown that strong mental emotions determine an augmented flow of blood to the cerebral vessels, and cause the production of spectral illusions. In all such cases there is a marked tendency to insomnia present. The account given by Nicolai, a celebrated German traveler of the last century, of his own disorder, is so interesting and appropriate that I quote it in full. It has never to my knowledge been published in this country.

"During the ten latter months of the year 1790 I had experienced several melancholy incidents which

deeply affected me, particularly in September, from which time I suffered an almost uninterrupted series of misfortunes that affected me with the most poignant grief. I was accustomed to be bled twice a year, and this had been done on the 9th of July but was omitted to be repeated at the end of the year 1790. I had, in 1783, been suddenly taken with a violent vertigo, which my physicians attributed to obstructions in the fixed vessels of the abdomen brought on by a sedentary life and a continual exertion of the mind. This indisposition was successfully removed by means of a more strict diet. In the beginning I had found the use of leeches applied to the arms particularly beneficial, and they were afterward repeated two or three times annually when I felt congestions in the head. The last leeches which had been put on previous to the appearance of the phantasms of which I am about to speak, had been applied on the 1st of March, 1790; less blood had consequently been evacuated in 1790 than was usual with me, and from September I was constantly occupied in business which required the most unremitted exertions, and which was rendered still more perplexing by frequent interruptions.

"I had, in January and February of the year 1791, the additional misfortune to experience several extremely unpleasant circumstances, which were followed on the 24th of February by a most violent altercation. My wife and another person came into my apartment in the morning in order to console me, but I was too much agitated by a series of incidents which had most powerfully affected my moral feelings to be capable of attending to them. On a sudden I perceived at about the distance of ten steps, a form like that of a deceased

person. I pointed at it, asking my wife if she did not see it. It was natural that she should not see anything; my question, therefore, alarmed her very much, and she sent immediately for a physician. The phantom continued for about eight minutes. I grew at length more calm, and being extremely exhausted, fell into a restless sleep which lasted about half an hour. The physician ascribed the appearance to violent mental emotion, and hoped there would be no return; but the violent agitation of my mind had in some way disordered my nerves and produced further consequences which deserve a more minute description.

"At four in the afternoon the form which I had seen in the morning reappeared. I was by myself when this happened, and being rather uneasy at the incident, went to my wife's apartment, but there likewise I was accompanied by the apparition, which, however, at intervals disappeared, and always presented itself in a standing posture. About six o'clock there appeared also several walking figures which had no connection with the first.

"After the first day the figure of the deceased person no longer appeared, but its place was supplied by many other phantasms, sometimes representing acquaintances, but mostly strangers. Those whom I knew were composed of living and deceased persons, but the number of the latter was comparatively small. I observed that the persons with whom I daily conversed did not appear as phantasms, these representing chiefly persons who lived at some distance from me.

"These phantasms seemed equally clear and distinct at all times and under all circumstances, both when I was by myself and when I was in company, and as well in the day as at night, and in my own house as well as

abroad; they were, however, less frequent when I was in the house of a friend, and rarely appeared to me in the street. When I shut my eyes these phantasms would sometimes vanish entirely, though there were instances when I beheld them with my eyes closed; yet when they disappeared on such occasions, they generally returned when I opened my eyes. I conversed sometimes with my physician and my wife of the phantasms which at the moment surrounded me. They appeared more frequently walking than at rest, nor were they constantly present. They frequently did not come for some time, but always reappeared for a longer or shorter period, either singly or in company, the latter, however, being most frequently the case. I generally saw human forms of both sexes, but they usually seemed not to take the smallest notice of each other, moving as in a market-place where all are eager to pass through the avenue; at times, however, they seemed to be transacting business with each other. I saw also several times people on horseback, dogs and birds. All these phantasms appeared to me in their natural size, and as distinct as if alive, exhibiting different shades of carnation in the uncovered parts as well as different colors and fashions in their dresses, though the colors seemed somewhat paler than in real nature. None of the figures appeared particularly terrible, comical, or disgusting, most of them being of an indifferent shape, and some presenting a pleasing aspect. The longer these phantoms continued to visit me the more frequently did they return, while at the same time they increased in number. About four weeks after they had first appeared, I also began to hear them talk. The phantoms sometimes conversed among themselves, but more frequently addressed their dis-

course to me: their speeches were commonly short and never of an unpleasant turn. At different times there appeared to me both dear and sensible friends of both sexes, whose addresses tended to appease my grief, which had not yet wholly subsided: their consolatory speeches were in general addressed to me when I was alone. Sometimes, however, I was accosted by these consoling friends while I was engaged in company, and not unfrequently while real persons were speaking to me. These consolatory addresses consisted sometimes of abrupt phrases, and at other times they were regularly executed.

"Though my mind and body were in a tolerable state of sanity all this time, and these phantasms became so familiar to me that they did not cause me the slightest uneasiness, and though I even sometimes amused myself with surveying them, and spoke jocularly of them to my physician and my wife, I yet did not neglect to use proper medicines, especially when they began to haunt me the whole day and even at night, as soon as I waked.

"At last it was agreed that leeches should be again applied to me as formerly, which was actually done, April 20th, 1791, at eleven o'clock in the morning. No person was with me besides the surgeon, but during the operation my chamber was crowded with human phantasms of all descriptions. This continued uninterruptedly till about half an hour after four o'clock, just when my digestion commenced. I then perceived that they began to move more slowly. Soon after their color began to fade, and at seven o'clock they were entirely white. But they moved very little, though the forms were as distinct as before, growing, however, by degrees more obscure yet not fewer in number, as had

generally been the case. The phantoms did not withdraw, nor did they vanish, a circumstance which, previous to that time, had frequently happened. They now seemed to dissolve in the air, while fragments of some of them continued visible for a considerable time. About eight o'clock the room was entirely cleared of my fantastic visitors.

"Since that time I have felt twice or three times a sensation as if these phantasms were going to reappear, without, however, actually seeing anything. The same sensation surprised me just before I drew up this account, while I was examining some papers relative to these apparitions, which I had drawn up in the year 1791."

While it is doubtless true that variations in the amount of blood in the brain are primarily dependent upon nervous action, it is equally certain that this latter is increased or lessened according as the brain is in a more or less hyperæmic condition. These factors, therefore, react upon each other, and consequently the resulting insomnia is more aggravated than would otherwise be the case.

Instances of insomnia dependent upon intense intellectual exertion have already been given, but the following, which I extract from my note-book, will not, I think, prove uninteresting or uninstructive:

Case V.—A gentleman, aged thirty-nine, unmarried, of correct habits, and good general health, consulted me on the 19th of April, 1865, in reference to a peculiar nervous affection with which he had suffered for several months. He stated to me that, being engaged upon a literary labor of some importance, he had given the greater part of his time to the studies necessary to its being carried

on with success, and was conscious of having overtasked his mental powers. So great, however, was his ambition to excel in his undertaking, that he had persevered notwithstanding the admonitions of friends, and the still more pointed warnings he had received from his own sensations. Instead of sleeping, as had been his custom, from seven to eight hours, he rarely, for nearly a year, had slept more than four hours out of the twenty-four, and frequently even less than this. He did not, however, feel the want of sleep. In fact he was never sleepy, and if this had been the only ill consequence of his severe application I should probably not have had him under my charge at all, so little weight did he attach to the condition which it was of the first importance should be relieved.

The symptom of disordered action which attracted his attention most was an inability to concentrate his mind upon subjects about which he wished to write. There was no difficulty in maintaining a connected line of reasoning, except when he attempted to put his ideas on paper, and then he found it utterly impossible to direct his thoughts in a methodical way. He conversed with me very intelligently in reference to his case, and was perfectly conscious of the difficulty under which he labored. As an instance of the character of his disease, he said that the day before he came to see me he had reflected to his entire satisfaction upon certain points in literature which he was investigating, and that when he came to read over what he had written he found it was a tissue of the most arrant nonsense. The subject of his thoughts was the Greek drama, and the ideas in reference to it, which he communicated to me, were in the highest degree logical and interesting. He

then showed me the first page of what he had written, and though he was annoyed at the nonsenical strains of his language, he could not at the same time conceal his amusement at its utter absurdity. I quote a few lines from this paper.

"The rise of the Greek drama is not to be associated with the Homeric age of minstrelsy, nor to be discovered in the Cimmerian darkness of the north. It rests upon a foundation far anterior to either. It is found in the hearts of those men who look beyond a mere utilitarian idea, and who are able to conceive of the existence of beauty without the disturbance due to causes inseparably connected with the barbarism from which Greece emerged into that mythical age which created a god for every river and forest, and for every emotion of the heart or element of the mind. Lyric poetry and philosophy may claim the precedence of antiquity, but the power that could draw tears from eyes that had never before wept, or cause the hardened lines of stoicism to relax in smiles, is not to be despised or even elevated upon a pinnacle of greatness."

At the time of writing, his thoughts flowed so rapidly that he was not conscious of the disconnected nature of his composition. If he stopped, however, to read it over, he at once saw how thoroughly it misrepresented his conceptions. No matter what the subject, the same thing happened, and even the most trivial notes could not be written without language being used which was either perfectly without relation to the ideas he wished to communicate, or else in direct opposition to them. For instance, wishing to obtain a book from a friend, he found he had written the prayer of Socrates which concludes the Phædrus of Plato. On another oc-

casion, intending to indite an epistle to a lady who had sent him a volume of her poems, he discovered, when half through his letter, that he had requested her to accept one of his own books, and had then gone on to give his views relative to suicide and matrimony.

Upon questioning him, I ascertained that he went to bed generally about two o'clock in the morning; that he lay awake for an hour at least, during which his mind was exceedingly active; and that he rose between six and seven, took a sponge-bath, and ate a light breakfast. He then went to work, spending the day in reading, and in dictating to his sister, who wrote out his language *verbatim*. At six o'clock he dined plainly, and then again resumed his labors. He drank neither tea, coffee, nor any alcoholic liquor. Occasionally he took a cup of chocolate at breakfast.

The only indications of a disordered system other than those I have mentioned were, that his pulse was too frequent (104), that it was irritable and irregular; that he had had several attacks of slight vertigo and headache; that his eyes were brilliant and somewhat congested, and that pressure upon the closed lids caused considerable pain. His bowels, contrary to what might have been reasonably expected, were regular, and his appetite was generally good. His urine contained an excess of urea and of phosphates; oxalate of lime was also present. There was nothing in his condition which appeared to give him the least anxiety, beyond the impossibility of controlling his thoughts when writing, and this he attributed directly to overexertion of his mental powers. He had, however, tried the effect of suspending his studies for two or three weeks, but had not perceived that any benefit was derived from this

procedure. He had, therefore, returned to his occupations.

I told him very plainly that, unless he was prepared to forego his literary labors for several weeks at least, he would be in great danger of permanent injury to his mind; but that with the avoidance of severe mental exertion, and by the aid of other measures, I believed he could be restored. He demurred somewhat to the first condition, but finally promised to follow my advice implicitly.

Although I was unable to explain the fact that mental aberration should only be manifested when he wrote, I was confident that his condition was clearly the result of intense hyperæmia of the brain, and that if this could be dissipated, and sound, regular, and sufficient sleep be produced, the mental trouble would also vanish. I therefore directed that half a dozen dry cups should be applied to the nape of the neck every evening, that he should take a warm bath directly afterward, and that, while in the bath, cold water should be poured on his head. Instead of lying down when he attempted to sleep, I advised that he should assume the sitting posture, supporting his head on a hair pillow. All literary labor was to cease. Instead of the books he was in the habit of studying, he was to read novels. He was to compose himself for sleep at eleven o'clock at night, and was to rise punctually at seven; take his sponge-bath as usual, and, after eating a moderate breakfast, to do anything he liked, except studying or writing, till twelve o'clock, when he was to take a walk for an hour, then eat a biscuit, read light literature till four, and then ride on horseback till six, at which hour he was to dine, simply, but to the extent his appetite prompted him.

He had been in the habit of smoking one cigar a day (after dinner), and I allowed him to continue in this indulgence.

I am thus particular in stating my instructions, because I determined to see what could be done by hygienic measures, and others directed to the relief of the supposed cerebral congestion, without resorting to the use of drugs, so long as it was probable they would not be required. Opium and other medicines of the narcotic class would, I was satisfied, do more harm than good; bromide of potassium I reserved for use, should it become necessary to employ it.

I have every reason to believe that he complied faithfully with the directions given him, and ere long marks of decided improvement were visible. His pulse had fallen to 80, was regular and full; there were no more headaches and vertigoes; his eyes had lost their bloodshot appearance, and, above all, his sleep had become sound, and was of from seven to eight hours' duration nightly. As soon as he got settled in his easy chair for the night his eyelids began to close, and he slept steadily on till it was time for him to get up for the day. Three weeks were necessary to bring about these results in full, although amendment was manifested from the first. Yesterday, May 18th, I wrote him a note, requesting his permission to make use of his case in illustration of this memoir. The following is his answer: it is the first time he has written a line for a month:

"My dear Doctor:—If, in your opinion, my case is possessed of any value in a pathological point of view, I hope you will make such use of it as will best serve the ends of science. I make only one condition. You

know I am a literary man, and that my reputation as a student and author would suffer in the estimation of the critics were I suspected of insanity. It takes very little to form a foundation for such an assumption, and, perhaps, in my case, there would be more truth than fiction in the notion as applied to me. With the exception, therefore, of giving my name, you are at perfect liberty to dish me up for the satisfaction of all your medical friends.

"I shall come and see you to-morrow, and in the mean time believe me ever,

"Yours sincerely and gratefully,

"—— —— ——."

"P. S.—I have read the above over, and to my great delight find that I have said what I wanted to say. I would stand on my head with joy, were it not that you were desirous of keeping as much blood out of my noddle as possible. *Laus Deo.* Can I go to work Monday?"

I had no intention of letting him "go to work" on Monday, or for at least two weeks subsequently. I was of the opinion, however, that after that time he could resume his labors to a slight extent, and gradually extend them; not to the limit they formerly reached, but to that degree which, while they would add to his reputation as a man of learning, would not exhaust the organ which it was so essential for his objects to preserve in a condition of unimpaired vigor. The result has been all that either he or myself could have desired.

CASE VI.—A youth of fifteen was brought to me by his father, on the 16th of August, to be treated for obstinate wakefulness, the consequence of severe mental exertion at school several weeks previously. He had not

attended school since the last of June, but had scarcely slept more than an hour or two each night since that time, according to his own and his father's statement. He was a healthy well-grown lad, with a good appetite, and nothing unusual in his appearance beyond a slight look of weariness and anxiety in his face. During the day there were no hallucinations of any kind, and toward evening he invariably felt overpowered with sleep. As soon, however, as he lay down he heard voices repeating extracts from the lessons he had recently been learning, and his mind became occupied with imaginary scenes in which the gods and goddesses of mythology and the heroes and poets of antiquity played prominent parts, and the whole power of his attention was thus kept engaged with these and other scenes which were formed with astonishing rapidity. Toward morning he fell into an uneasy slumber, and awoke feeling more weary even than when he had gone to bed.

Medicines, among which opium was the chief, had been employed without success. On the contrary, his condition was manifestly rendered worse through their influence. Laudanum, of which he had taken large quantities, always caused headache, without producing the least amelioration in his symptoms. Notwithstanding the palpable connection which existed between the wakefulness and his former intense mental application, he had been allowed to continue his studies, and when he came to me had a Latin grammar in his hand, which he had been diligently studying in the street railway car!

After some very plain conversation with the father, relative to the great danger to which he was subjecting his son, by thus inordinately taxing his mind, I directed the entire cessation of all studies for the present, and

an entire change of associations by a visit to the sea-shore, and free indulgence in bathing, fishing, and other recreations. I likewise advised the use, for a few nights, of small doses of bromide of potassium. My advice was implicitly followed, and a few days since I received a visit from the boy's father, and was told by him that his son's health had been completely restored. I recommended that the visit to the sea-side should be prolonged a week or two, that the return to study should be gradual, and that the boy's eagerness to learn should be somewhat restrained by occupations and amusements requiring but little mental exertion.

2*d*. *Those positions of the body which tend to impede the flow of blood from the brain, and at the same time do not obstruct its passage through the arteries, while causing hyperæmia, also produce insomnia.*

Several cases have come under my observation in which the influence of position as affecting the disposition to sleep was well marked. It is very evident that the recumbent posture is more favorable to a state of congestion of the brain than the erect, or semi-erect. Individuals who, by excessive mental exertion, have lessened the contractility of the cerebral vessels, almost always experience great difficulty in getting to sleep after lying down, even though previous to so doing they may have been very drowsy. A gentleman, who was a patient of mine a few weeks since, informed me that several years ago he had an attack of wakefulness, which lasted for three or four months, and which was particularly characterized by inability to sleep while lying in bed. While sitting in his office he would often fall asleep in his chair, and previous to going to bed he

would be overcome by drowsiness. The moment, however, that he lay down, his mind was aroused into activity, and all sleepiness disappeared. He left off work, traveled, and in a short time recovered perfectly. It will be recollected that in the other cases I have cited in this memoir, the phenomena were always more strongly marked after the persons affected lay down; and I have always insisted upon the avoidance of the recumbent posture as one of the most important means to be employed in the cure of insomnia. The following is one of the cases referred to above.

CASE VII.—A gentleman in extensive legal practice requested my advice for persistent wakefulness, with which he had been affected for several weeks, in consequence of unremitting attention to a case in which his sympathies had become greatly interested. For somewhat over a month he had, as he informed me, slept but for an hour or two each day. After dinner he was able to procure this much sleep in his chair, but at night, when he lay down, all his efforts were unavailing. He felt the want of repose very much, and he described the sensation of weariness of body and mind as almost insupportable. So great was this desire for sleep that, notwithstanding repeated disappointments, he was confident each night of being able to secure it, but invariably as soon as he lay down, all inclination vanished, and he passed the night in that condition of painful restlessness which had now become horrible to him. There was no very great mental activity, and no hallucinations of sight, but when his head touched the pillow a low buzzing sound, which apparently had its origin in the ears, was heard, and remained there to keep him awake. He could not shut out this noise, no matter how energeti-

cally he endeavored to render himself oblivious to it, and all the means, such as opium, chloroform, and alcoholic liquors of various kinds, which he tried in the hope of obtaining relief, only aggravated the difficulty.

His general health, ordinarily excellent, had latterly began to give way. His bowels were torpid, he had little or no appetite, and he was almost daily subject to severe attacks of headache. He was conscious, too, of a very decided change in his disposition. From having been of rather social tendencies, he had become morose and gloomy, disliking even the companionship of his most intimate friends. There was also a very decided impairment of his memory, and he was sensible of the fact that the power of concentrating his attention upon subjects of even minor importance was materially weakened. In conversation he miscalled names, and misplaced events and things. Thus he called Pittsburg *Pittstown*, said *aunt* several times when he should have said uncle, and confounded *Newark* with New York. By attention to hygienic measures, avoidance of the recumbent position, and the use of moderate doses of bromide of potassium, he soon obtained a due amount of sleep, and the other symptoms of a disordered mental and physical organism gradually disappeared.

Dr. Handfield Jones* relates a case in which the influence of position was strongly marked. "A gentleman, aged twenty-four, after considerable mental strain, experienced the following symptoms: He was thoroughly weary and drowsy at the close of the day, and felt, as well he might, the need of nature's restorer; scarcely,

* Clinical Observations on Functional Nervous Disorders. London, 1864, p. 284.

however, had he laid down his head, when the cerebral arteries began to throb forcibly, and soon all inclination for sleep was banished, and for hours he lay wide awake, but deadly weary. The *causa mali* here was evidently deficient tonicity in the cerebral arteries, or more exactly paresis of their vasa motor nerves. As the arteries relaxed they admitted an undue flow of blood to the brain, which goaded the weary tissue into abnormal action."

De Boismont* refers to a case, on the authority of M. Moreau, in which an individual was able to obtain hallucinations of sight by inclining his head a little forward. By this movement the return of blood from the head was impeded, and thus there was an exaltation of certain of the cerebral functions.

Wakefulness is nothing more than an exaggeration of the normal functions of the brain. For this organ to act with vigor, an increased flow of blood is necessary. If this flow is continued, without proper periods of repose, a state of erethism and insomnia is produced. Instances have been recorded in which persons have found it necessary to assume the recumbent position whenever they had any severe mental labor to perform. The following extract, bearing upon this point, from a work† already quoted, is interesting:

"The posture of supination will unavoidably induce that increased flow of blood to the brain which, under certain states of this fluid, is so essential to the production of brilliant waking thoughts; and are indeed attained so often by another mode—the swallowing of opium.

---

* A History of Dreams, Visions, Apparitions, etc. American edition. Philadelphia, 1855.

† The Philosophy of Mystery. By Walter Cooper Dendy. London, 1841, page 290.

"A gentleman of high attainment was constantly haunted by a specter when he retired to rest, which seemed to attempt his life. When he raised himself in bed *the phantom vanished, but reappeared* as he resumed the recumbent posture.

"Some persons always retire to bed when they wish to think; and it is well known that Pope was often wont to ring for pens, ink, and paper in the night, at Lord Bolingbroke's, that he might record, ere it was lost, that most sublime or fanciful poesy which flashed through his mind as he lay in bed. Such, also, was the propensity of Margaret, Duchess of Newcastle, who (according to Cibber, or rather Shiel, the *real* author of the 'Lives of the Poets'), kept a great many young ladies about her person, who occasionally wrote what she dictated. Some of them slept in a room contiguous to that in which her grace lay, and were ready at the call of her bell to rise any hour of the night to write down her conceptions, lest they should escape her memory.

"Henricus ab Heeres (in his 'Obs. Med.') says that when he was a professor he used to rise in the night, open his desk, compose much, shut his desk, and again to bed. On his waking, he was conscious of nothing but the happy result of his composition.

"The engineer Brindly even retired to bed for a *day or two*, when he was reflecting on a grand or scientific project.

"I deny not that the darkness or stillness of night may have had some influence during this inspiration. I may also allow that some individuals compose best while they are walking, but this *peripatetic* exertion is calculated itself to produce what we term determination of blood to the head. I have heard of a most remarkable

instance of the power of position in influencing mental energy in a German student who was accustomed to study and compose with his head on the ground, and his feet elevated and resting against the wall.

"And this is a fragment of a passage from Tissot, on the subject of monomania.

"—— 'Nous avons vu étudier dans cette académie il n'y a pas long temps, un jeune homme de mérite qui *s'étant mis dans la tete*, de découvrir la quadrature du circle, est mort, fou à la hôtel Dieu à Paris.'*

"You will smile when I tell you that the tints of the landscape are brighter to our eyes if we *reverse the position of the head.*"

Tissot, in the work to which reference has just been made, cites an instance in which position was taken advantage of to solve a problem in mathematics. A gentleman, remarkable for his accuracy in calculation, for a wager *lay down on a bed* and wrought, by mere strength of memory, a question in geometrical progression, while another person, in another apartment, performed the same operation with pen and ink. When both had finished, the one who had worked mentally repeated his product, which amounted to sixteen figures, and, insist-

---

* It is perhaps scarcely necessary to call attention to the fact that Mr. Dendy has altogether mistaken the signification of the words in the above quotation from Tissot, printed in italics. He appears to think they mean *being put on his head*, a translation which would make very great nonsense out of the whole extract. The words will be found in Tissot's *Avis aux Gens de Lettres et aux Personnes sedentaires sur leur santé*, Paris, 1768, p. 28, and in English, in a translation entitled "*A Treatise on the Diseases of Literary and Sedentary Persons, Edinburgh,*" 1772, p. 26. The work is well worthy of attention even at this day, as containing many most interesting facts and important suggestions.

ing that the other gentleman was wrong, desired him to read over his different products. On this being done he pointed out the place where the first mistake lay, and which had run through the whole. He paid very dearly, however, for gaining his wager, as for a considerable time he had a swimming in his head, pains in his eyes, and severe headaches upon attempting any mathematical labor.

Sir Walter Scott has said somewhere, that the half hour *passed in bed*, after waking in the morning, was the part of the day during which he conceived his best thoughts.

Dr. Forbes Winslow* makes some excellent remarks upon the relations existing between position and wakefulness. He says:

"In some types of insanity the patient's mind is altogether absorbed in the contemplation of a frightful spectral illusion. Under these circumstances the unhappy sufferer is afraid to close his eyes in sleep from an intense fear and dread that he will then fall an easy prey to the horrible phantasms which his morbid imagination has called into existence, and which, he imagines, follow him in all his movements. The patient so afflicted declares he will not sleep, and resolutely repudiates and perseveringly ignores all disposition to slumber. On many occasions he obstinately refuses to go to bed, or to place himself in a recumbent position. He will battle with his attendant if he attempts to convey him to bed. He insists on remaining in the chair, in standing in an erect position all night, and often determinately walks about the room when those near him are in pro-

* On Obscure Diseases of the Brain, etc., p. 607.

found repose. In these cases the hallucinations appear to be most exquisitely and acutely vivid when the patient is placed in a recumbent position, on account, it is supposed, of the mechanical facilities thus afforded for the blood gravitating freely to the head.

"A gentleman who appeared free during the day from any acute hallucinations, never could lie on his back without being distressingly harassed by a number of frightful imps whom he imagined to be dancing fantastically around him during the night. Under these circumstances, undisturbed sleep, while in bed, could never be obtained. He was in the habit of sleeping in an armchair for some time in consequence of these symptoms. He, however, eventually recovered, and has been for several years entirely free from all hallucinations."

It has frequently occurred to me to notice the increase in the number and intensity of the hallucinations of patients affected with delirium tremens as soon as they assumed the recumbent position. The difficulty of sleeping is in such cases always correspondingly augmented.

3d. An increased amount of blood is determined to the brain, and wakefulness is produced by certain substances used as food or medicine.

Daily experience assures us of the truth of this proposition. In general terms it may be said, that all those substances which, when ingested into the system, increase the force and frequency of the heart's action, cause also a hyperæmic condition of the brain and tend to the supervention of wakefulness.

Chief among these agents are to be placed alcohol, opium, belladonna, stramonium, Indian hemp, tea, and

coffee. It is true that the first two of these, when taken in large quantities, sometimes give rise to a comatose condition. This, however, as has already been shown, is not a consequence of an increased amount of blood in the brain, but results from the circulation in that organ of blood which has not been duly oxygenated by respiration. My experiments on this head have been many, and show conclusively that neither alcohol nor opium possesses any stupefying effect, if means be taken to insure the full aeration of the blood. If, however, these substances be administered beyond a certain limit, they so act upon the nerves which supply the respiratory muscles as to interfere with the process of respiration, and hence the blood is not sufficiently subjected to the action of the atmosphere. Unaerated blood therefore circulates in the brain, and coma—not sleep—is produced.

No substance is capable of acting as a direct hypnotic, except that which lessens the amount of blood in the brain. In small doses alcohol and opium do this indirectly, through their stimulating properties exerted upon overdistended blood-vessels, as has been shown in regard to the first named, in a case already cited; but they never so act upon the healthy brain. In the normal state of this organ their action in small doses is always that of excitants. The word "small" is of course used in a relative sense. What is a small dose for one person may be a large one for another, and *vice versa.*

In this connection it is scarcely necessary to dwell at any length upon the wakefulness produced by delirium tremens from the excessive ingestion of alcohol or opium. In the *post-mortem* examinations—four only—which I have made of individuals dying from this affection as the result of the immediate use of alcohol, the brain was in-

variably found congested. Either hyperæmia, or its consequence, effusion of serum, is the ordinary pathological condition discovered in such cases.

In regard to opium, most practitioners have doubtless noticed the effect which it and its preparations frequently produce in preventing sleep. I have known one dose of half a grain of opium keep a patient awake for three consecutive days and nights, during the whole of which period intense mental excitement was present. As is well known, the Malays, when they wish *to run amuck*, bring on the necessary degree of cerebral stimulation by the use of opium. During the condition thus produced insomnia is always present. It is certainly true, however, that in moderately large doses opium acts as a direct hypnotic, and the same may be said of other narcotics.

Belladonna, stramonium, and Indian hemp likewise produce congestion of the brain and wakefulness. The latter, under the name of *hashish*,* is still used in the East to bring on a state of delirium, and, if rumor is to be credited, has its votaries in this country. Tea and coffee act in a similar but far less powerful manner. As one of the results of experiments with these substances, instituted upon myself, I found that the circulation of the blood was rendered more active.† Their influence in preventing sleep is well known to the generality of peo-

---

* The word *assassin* is derived from the word *hashish*, from the fact that a sect in the East called *Assassins* made use of *hashish* to induce the temporary insanity during which their crimes were perpetrated. See *History of the Assassins*, by the Chevalier Joseph von Hammer, translated from the German, by O. C. Wood, M.D., London, 1835, p. 233, note.

† Physiological Memoirs, 1863, p. 24, *et seq.*

ple, and this effect is doubtless entirely due to their action upon the heart and blood-vessels by which the amount of blood in the brain is increased. In persons of fair and thin skins, who are not accustomed to the use of either of these beverages, the face can be seen to flush after they have been taken; and I have frequently met with persons in whom their use was always followed by suffusion of the eyes, and a feeling of fullness within the head. Their power to increase the force and brilliancy of our thoughts, and to sustain the mind under depressing influences, has long been recognized, and is to be ascribed to the same cause as that which prevents sleep.

4th. Wakefulness is also caused by functional derangements of certain organs of the body, whereby an increase in the amount of blood in the brain is produced.

Under this head are embraced those cases of sleeplessness due to exalted sensibility of the nervous system. They are chiefly met with in persons of feeble constitution. The slightest impression made upon the skin, or any other organ of sense, is converted into a sensation out of all proportion to the exciting cause. There is thus a condition of general hyperæsthesia which greatly tends to the prevention of sound and refreshing sleep. The following case illustrates very well the phenomena of the state in question:

CASE VIII.—A lady recently came under my care for extreme wakefulness, the result, as she correctly supposed, of debility. During the month of August she had resided in a malarious region, and had had a series of attacks of intermittent fever before she would consent to take quinine for its cure. By the time the disease was conquered she had become very much reduced, and

her constitution had received a shock from which it will probably not recover for several years. I saw her for the first time on the 26th of September, and she was then so feeble that she was unable to be out of her bed for more than an hour or two each day. Her nervous system was in an exceedingly irritable condition, the least noise startled her, she was unable to bear the full light of day, and so sensitive was her skin, that the light clothes she wore caused her the greatest uneasiness. She informed me that she had not slept a particle for seventeen days and nights, and though I received this statement with some grains of allowance, I was very sure, from her general appearance, that she was suffering from insomnia. At night the feeling of general discomfort was greatly increased, the weight of the bedclothes was insupportable, and she passed the hours tossing restlessly on her bed or in walking the floor. By morning she was feverish, irritable, and thoroughly exhausted. A cup of coffee and a little buttered toast constituted her breakfast, after which she felt somewhat revived.

Conceiving that all the symptoms were referable to debility and passive cerebral congestion, I advised nutritious food, tonics, stimulants, exercise in the open air, the warm bath, cold water to the head, and the avoidance of the recumbent posture. Amendment began almost immediately, and by the end of a week the hyperæsthesia had disappeared, and she slept soundly and sufficiently.

In reference to this form of wakefulness, Dr. Handfield Jones* makes some judicious observations. He

* On Functional Nervous Disorders. London, 1864, p. 282.

says: "A girl recently under my care with very various and marked signs of prostration of nerve-power, suffered for many months with exceedingly restless nights, the cause of which appeared to be chiefly great hyperæsthesia. Although she improved materially in other respects, she did not sleep well until she was removed from London to a healthy part of the country. I have had several patients, two especially, both temperate males, who for a length of time were quite dependent for good rest at night on wine taken either on going to bed or in the course of the night. * * * It is not easy to form a precise idea of the state of the nervous centers in which a 'night cap,' as above mentioned, is so effectual in procuring sleep. Debility is certainly one marked pattern of it, but there must be surely another, even more important, as the most profound debility does not, by any means, always interfere with sound sleep, nay, rather seems to conditionate it. This other element, we are much disposed to think, is hyperæsthesia, or irritability, which, as already noticed, commonly increases *pari passu* with weakness. The condition may be compared with that of neuralgia, when it is beginning to give way under treatment, and is so readily reproduced by anything which causes exhaustion. Now as the stimulant recruits the exhausted nerve-force, the hyperæsthesia ceases, and the brain tissue subsides into a state of calm repose. It may be added here that it is often well to give not only a stimulant, but also some digestible nourishment about the time of going to rest, or even in the course of the night when debility to a serious extent exists. It is quite certain that a craving empty stomach is by no means favorable to quiet slumber, and in this point of view moderate suppers are far

from being unsuitable to many invalids. I well remember the case of a lady who, the night after a natural confinement, woke up with severe gastric disorder and flatulence, which resisted various medications, but subsided immediately after a plate of cold meat and some brandy and water. Among the various soporifics, I doubt if there be any more potent, especially for the weakly and hyperæsthetic, than prolonged exposure to the cold open air. This should be so managed as not to cause great fatigue, and if well timed and followed by a sufficient meal, it will be found an admirable preparation for sound nightly slumber."

In the foregoing remarks it is perceived that Dr. Jones fails to recognize the state of passive congestion of the brain which in cases such as he describes, and in many similar ones which have come under my care, is almost invariably present. It is this feature which, in addition to the debility, gives so marked a character to the species of insomnia under consideration. The hyperæsthesia, like the wakefulness, is merely a result of the cerebral hyperæmia.

Several cases of insomnia, the result of disordered menstruation, have come under my observation. We can very well understand how, in women suffering from suppression of this function, a slight degree of cerebral hyperæmia and consequent wakefulness should result. About the climacteric time of life, when irregularities in the menstrual flow are very common, there is quite generally extreme sleeplessness as each period approaches, which is not ordinarily relieved till the catamenia make their appearance. In such cases measures directed to the relief of the existent congestion of the brain will generally prove effectual in causing natural sleep.

Irregular or deficient action of the heart and blood-vessels is a frequent cause of wakefulness. One of the principal results of such disordered action of the circulatory organs is coldness of the extremities, and an attendant condition of repletion of the central vessels. As a consequence there is in these cases almost invariably great wakefulness. As Dr. Cheyne* has remarked, many a delicate female, from going to bed with cold feet, is deprived of hours of sleep in the early part of the night, and thereby falls into nervous complaints, obstinate dyspepsia, and uterine irregularity, who might have escaped had the circulation of the surface of the body been properly sustained.

There are cases, however, of habitual cold feet, accompanied by wakefulness, which are not so much due to deficient power in the heart as to disordered nervous action. But, whatever the cause, there is always, while the condition exists, an excessive amount of blood in the cranial vessels. An instance of the kind came under my observation several years ago in the person of an army officer, of strong constitution and otherwise of good health. Heat applied to the extremities gave only temporary relief, and stimulants taken internally were equally inefficacious. He was finally entirely cured by the repeated passage of the direct galvanic current through the sciatic and crural nerves and their branches.

Indigestion is quite a common cause of wakefulness, even when no marked disagreeable sensations are experienced in the digestive organs. A full meal, especially if it be of highly seasoned or otherwise improper food, will often keep the offending individual awake the

* Cyclopedia of Practical Medicine, vol. iv., art. Wakefulness.

greater part of the night. We know that apoplexy is especially apt to occur soon after the stomach has been overloaded with food. The return of the blood from the head is impeded, and the rupture of an intercranial vessel, or an effusion of serum, is the result of the cerebral congestion. Insomnia is a milder effect of the same cause.

There are several other abnormal conditions of the system in which wakefulness plays an important part, but their consideration would lead us into the discussion of the phenomena of many diseases of which it is simply a symptom, or of secondary consequence. The remarks which have been made in regard to it have reference to its existence as an evidence of slight cerebral congestion, and therefore as being of sufficient importance to demand the aid of both physician and patient in effecting its cure.

CHAPTER IV.

THE TREATMENT OF WAKEFULNESS.

THE principles which should prevail in the treatment of wakefulness are indicated to some extent by the remarks which have already been made. If the views which I have given relative to the pathology of this affection be correct, there can be no doubt in regard to the means to be employed for its cure. Happily theory and practice are in perfect accord in respect to the therapeutical measures to be adopted. These may be arranged into two classes:

1st. Those which by their tendency to soothe the nervous system, or to distract the attention, diminish the action of the heart and blood-vessels, or correct irregularities in their function, and thus lessen the amount of blood in the brain.

2d. Those which directly, either mechanically or through a specific effect upon the circulatory organs, produce a similar effect.

Under the first head are embraced many agencies which from time immemorial have been known to cause sleep. Among them are music, monotonous sounds, gentle frictions of the surface of the body, soft undulatory movements, the repetition by the insomnolent of a series of words till the attention is diverted from the exciting emotion which engages it, and many others of similar character which individuals have devised for

themselves. In slight cases the measures belonging to this class often prove effectual, but in persistent insomnia they are generally altogether nugatory.

Under the second head we shall find comprehended the means which are chiefly to be relied on in the treatment of cases of morbid wakefulness.

Chief among them are embraced those measures which tend to improve the general health of the patient, and which are chiefly of a hygienic character. Whatever causes produce an irritable condition of the nervous system, indirectly at least increase the disposition to wakefulness. It is important, therefore, that these should be thoroughly understood and avoided, and I accordingly propose to consider them at some length.

Food.—While it is an error to suppose, as is generally done, that a moderately full meal, eaten shortly before bedtime, is necessarily productive of wakefulness, there is no doubt that this condition is induced by an excessive quantity of irritating or indigestible food. A hearty supper of plainly cooked and nutritious food rather predisposes to sleep. Most of us have experienced the drowsiness which so often follows dinner. This is due to the fact that the process of digestion requires an increased amount of blood in the organs which perform it, and consequently the brain receives a less quantity. A tendency to sleep is therefore induced. It is a natural and healthy predisposition, and when yielded to moderately conduces to a more complete assimilation of the food than would otherwise take place. When, however, the food ingested is not such as is merely sufficient for the wants of the system, but is inordinate in amount, or irritating in quality, the hypnotic effect is neutralized, and often a state of wakefulness supervenes, from the

fact that the quantity of blood circulating in the brain is augmented instead of being diminished. This last result is induced either by the pressure of the overloaded stomach upon the abdominal vessels or through a reflex action on the heart, by which it is excited to increased activity.

In young children, who are very susceptible to the influence of causes acting upon the nervous system, we often see both sleep and wakefulness result as direct effects of eating. When the quantity of milk taken has not been excessive, the child quietly drops asleep at the breast. On the contrary, when a superabundance has been ingested, it either remains awake or the sleep is disturbed. In adults it is, as has already been mentioned, not uncommon for apoplexy to ensue upon a large meal of improper food.

In order, therefore, that a disposition to wakefulness may be removed, it is essential that attention should be paid to the diet of the affected individual. As a rule, people are underfed. This is especially the case with women, who too generally indulge in what may be called "slops," to the exclusion of good, solid, nutritious food derived in great part from the animal kingdom. By such a faulty diet the tone of the system is lowered, and local congestions of different parts of the body are produced. If the brain be one of these, wakefulness results.

Most of the cases of insomnia which occur in women are of the passive variety, and require not only nutritious food, but *stimulants*. Of the latter, *whisky* is generally to be preferred as acting rapidly, as less likely to disagree with the stomach than many kinds of wine, and as being purer than the stuff ordinarily sold as brandy. As a good stimulant, and at the same time tonic, nothing

can be preferable to *Tarragona wine*, drunk at dinner to the extent of a glass or two. It possesses all the essential qualities of pure port, and is much more reliable and wholesome than the mixture of elderberry juice and alcohol which passes for this latter wine. Next to Tarragona wine must be ranked good *lager beer*.

Although the effect of *coffee* is generally such as to induce sleeplessness, there are cases in which its action is directly the reverse. I have had several slight cases of passive wakefulness under my care which were entirely and speedily cured by a cup of strong coffee taken for three or four nights in succession at bedtime. It is especially useful in females of languid circulation, and a consequent tendency to internal congestions.

Stimulants such as those mentioned, and others which might be noticed, it must be clearly understood are only useful in the asthenic or passive form of insomnia; in the sthenic or active form of the affection they are altogether inadmissible, and if employed will certainly increase the difficulty.

The good effects of moderate but regular *physical exercise* in dissipating wakefulness can scarcely be overestimated. It is almost impossible to produce any permanently beneficial influence without the aid of this powerful tonic. To be of any material service, the exercise should be taken in the open air, and should extend to the point of inducing a slight feeling of fatigue.

The *warm bath* is also a very valuable means of determining blood from the head, and calming nervous irritability. Frequently, especially in children, I have found that simply putting the feet in water of the temperature of 100° F., has been sufficient to induce a sound and

healthy sleep, when laudanum and other means have failed.

Cold water, applied directly to the scalp, is often of great effect in diminishing the amount of blood in the brain. It is not admissible in the asthenic form of wakefulness. When the individual is strong, the heart beating with force and frequency, and the mental excitement great, its influence is almost invariably good. The exact temperature is a matter for the judgment of the physician. I have often used it as cold as ice could make it, 32° F., or thereabouts.

In the action of cold water, applied to the head in cases of insomnia, we have another proof of the real nature of this affection. It is known that in Thibet mothers place their wakeful children in such positions as will admit of a small stream of cold water falling from a slight elevation upon the head. I have in some work—on which I cannot now lay my hands—read a very full account of this custom, and seen a cut representing the process. The children very soon fall into a quiet sleep. I have often seen the application of the cold *douche* to the heads of refractory prisoners bring on a deep sleep.

The effects of *position* in aid of other remedies have also been alluded to. I make use of its advantages in all severe cases of insomnia which come under my charge, and we have, in its efficacy, additional confirmation of the correctness of the theory that the condition of the brain in such cases is one of hyperæmia.

Among the more purely medicinal agents, *bromide of potassium* occupies the first place, and can almost always be used with advantage to diminish the amount of blood in the brain, and to allay any excitement of the nervous system that may be present in the sthenic form of in-

somnia. That the first named of these effects follows its use, I have recently ascertained by experiments upon living animals, the details of which will be given at another time. Suffice it now to say, that I have administered it to dogs whose brains had been exposed to view by trephining the skull, and that I have invariably found it to lessen the quantity of blood circulating within the cranium, and to produce a shrinking of the brain from this cause. Moreover, we have only to observe its effects upon the human subject to be convinced that this is one of the most important results of its employment. The flushed face, the throbbing of the carotids and temporals, the suffusion of the eyes, the feeling of fullness in the head, all disappear as if by magic under its use. It may be given in doses of from ten to thirty grains—the latter quantity is seldom required, but may be taken with perfect safety in severe cases.

Opium I very seldom employ in the treatment of wakefulness, from the facts that its effects vary so greatly in accordance with the dose, and that its action is not limited to the simple induction of sleep. There are cases, however, in which its influence is decidedly beneficial. Care should be taken to give it in sufficiently large but not excessive quantities. The influence of opium in lessening the amount of blood in the brain is very distinctly recognized by Dr. Handfield Jones, and also by Dr. Alfred Stillé.* Both these authors account in this manner for its hypnotic effect. As has been shown, my own experiments tend strongly to confirm this reasoning.

Hyoscyamus is more generally admissible. It is es-

---

* Therapeutics and Materia Medica, 2d edition. Philadelphia, 1864. Vol. ii. page 659.

pecially indicated in those cases which are accompanied by great nervous irritability. It is difficult to obtain any preparation of this drug which retains its virtues. I have usually employed the tincture in doses of from one to two drachms. I do not think, however, that it possesses any advantages over bromide of potassium, or that it is even equal in any respect to this agent.

In regard to *valerian*, *assafœtida*, and other *antispasmodics*, I have nothing to say in commendation. *Tonics* are, however, almost always useful, even in the active form of the affection. Among them *quinine* and *iron* are more generally indicated.

When wakefulness is a consequence of functional derangement of distant organs, the measures of relief must be directed to the cure of the primary disease, in order to produce any permanent alleviation of the cerebral difficulty.

In those cases of insomnia dependent upon severe and long-continued mental exertion, all means will fail to remedy the trouble unless the affected individual consents to use his brain in a rational manner. Proper intervals of relaxation should be insisted upon, and in some cases it may be necessary to suspend all intense intellectual effort for a time. When the means will permit, travel can always be undertaken with advantage. It is surprising sometimes to see how rapidly the brain recovers its tone, and the system generally recuperates through the change of associations and scenes incident to travel.

The disposition of the age seems to be to ignore the fact that the nervous system can exhaust itself by excessive intellectual labor. A short time since intelligence was received from abroad that one of the most distinguished men of Great Britain had committed suicide, in

consequence of insanity produced by overexertion of his mind. Thus one more victim is added to the long list of those who have disregarded the laws of their being; and again we are reminded that there is a limit to the exercise of our intellectual powers, beyond which we cannot pass with safety.*

---

* The instance alluded to, that of Admiral Fitzroy, is thus commented upon by the *Spectator* of May 6th, 1865:

"Admiral Fitzroy, the well-known meteorologist, committed suicide on Monday morning at his own house. He had overworked himself of late; found that he was losing his memory; became sleepless, and resorted to opium to obtain ease, which aggravated his symptoms. His doctor had warned him that he ran great risk of paralysis, but from a false tenderness did not at once compel him to give up labor."

The *London Review* of the same date says: "He (Admiral Fitzroy) acquired that terrible inability to sleep, which is one of the most dreadful of those means by which nature avenges the abuse of the mental powers, and he was forced to take opium at night; at one time to an extent which threatened serious consequences."